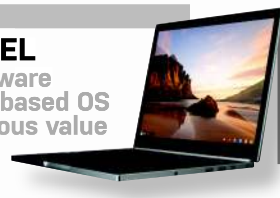
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We test the mettle of the world's first gaming tablet
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Luxurious hardware meets browser-based OS and offers dubious value
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Gordon Mah Ung

WHY WE BUILD

I'VE HEARD from plenty of OG nerds who have long since given up on rolling their own rigs. They almost always ask the same question: "People still build PCs?" or "Why build?"

Look, I'm not against buying a PC, and I believe there are actually tons of good reasons to buy a prebuilt PC, such as support, warranty, and better pricing than you or I could ever get by building. OEMs also offer expertise and/or technology that's inaccessible to most home builders—such as outfitting a three-way SLI machine with custom water-cooling, or building in a nifty mini-tower chassis that the public can't get. And to be honest, I'd much rather have a relative or friend buy an OEM machine than to custom-build one because I don't want to be on the hook for the 3 a.m. calls. Let's not even get into laptops, which are verboten to DIYers.

But none of those reasons take away from the pure joy I get out of building a PC. Getting a seat in our little budget build-off was a plain hoot. For a hardcore PC nerd, there's nothing so exciting as sorting through parts lists looking for just the right components that will let you vanquish your foes. Tom, Chris, and I spent an afternoon taunting one another over our respective hardware choices and then sweating bullets when we realized a competitor's machine might actually be better. Once all the parts were in house, we built the machines side-by-side in our common area so we could peer over each other's shoulders. I mean, I did have a spare Core i7-3770K—no one would notice, right?

This got me thinking, why do we build?

We build because we like the control we get—from the parts selection, to the color, to even the shape and size of the case. We can wire it tight or leave it messy. (Yeah, I left my budget rig messy. I charge $5 to clean up wiring.)

We build because it's cathartic. Yeah, the day sucked, the bills came in, and you just had a spat with your spouse, girlfriend/boyfriend, or pet, but nothing makes it all fade away like cracking open a stack of boxed hardware you've been collecting and finally building that brand-new rig. When the last part is installed and you're installing the OS, it's better than Miller time.

We build because we're green. My co-workers think I'm nuts when I try to save even an old stock Intel LGA775 cooler or a box of DDR2 RAM, but I do it because I know eventually I'll have enough leftover parts to assemble a PC and set it loose rather than sending it to the big e-waste bin in the sky.

One last thing: We build because we love PCs.



Gordon Mah Ung is Maximum PC's deputy editor, senior hardware expert, and all-around muckraker.

↘ submit your questions to: comments@maximumpc.com

THE NEWS

AMD Shows Off Its Dual-GPU HD 7990

Nvidia's GTX 690 finally has some serious competition in the form of this 12-inch monster

More than a year after Nvidia released its flagship dual-GPU GTX 690, AMD has finally responded with its own dual-GPU card dubbed the Radeon HD 7990. It's a card we all figured must have existed, but a lack of news from AMD and the arrival of dual-GPU cards from some of its partners had us convinced that AMD had simply passed on the challenge of creating a dual-Tahiti board that could not only outperform the GTX 690, but operate quietly while doing so. According to AMD, it has successfully achieved both of these goals. And unlike the PowerColor Devil 13, this card will run nice and quiet, and requires only two 8-pin PCIe power connectors.

SOME BIG NUMBERS

Let's take a look at the card's digits, since you are probably anxious to specturbate. Since it combines two HD 7970 GPUs in CrossFireX, its specs are exactly doubled (but with slightly lower clock speeds, which is the norm for cards of this caliber). Transistor count is 8.6 billion, with 4,096 stream processors. Clock speeds are set at 950MHz, with a 1,000MHz boost clock, it uses 6GB of RAM (in a CrossFire setup, so 3GB will be visible), and it's 12 inches long. TDP is 375W, and cooling for the dual-slot card is provided by a massive heatsink with three fans. AMD says the card is 10 decibels quieter than a GTX 690 under full load, making it even quieter than what's considered the norm for a "quiet office." Like Nvidia did with the GTX Titan, AMD is marketing this GPU to people running 4K panels or multiple LCDs, instead of those with a single display, as it's mostly overkill for today's titles (not that there's anything wrong with overkill). In benchmark charts provided by AMD, the HD 7990 was a tad faster than the GTX 690 at 4K resolution in games ranging from Far Cry 3 to Battlefield 3 and Crysis 3. The card, which will no doubt be expensive (pricing info was not available at press time), will come with a total of 10 games from AMD's "Never Settle" bundle, which includes almost every triple-A title released in the past year, along with one unannounced mystery title (our guess is Battlefield 4).

CURIOUS TIMING

The first question asked at the presser for the card was, "Why now?" Why did AMD wait this long to introduce its dual-GPU response to the GTX 690? The answer is probably one we'll never know for certain, but we can make several guesses. The first is the company's acknowledged issue with microstutter in CrossFireX configurations, which reportedly is addressed in this card. The remedy appears to be a software solution that lets the user control the input delay, though we haven't had a chance to test it yet. It's possible AMD needed time to create this software patch before deploying the biggest gun in its arsenal. Another theory is that AMD had this card all along, but once it saw the GTX 690 it was "back to the drawing board," so to speak. The HD 7970 always ran hotter and louder than the GTX 680, so it's quite possible AMD just needed more time to iterate its design to the point where it could be competitive in terms of performance and power. –Josh Norem



AMD eschewed the triple-slot design of the PowerColor Devil13 and the water-and-air-cooled setup of the Ares II in favor of a longer but much quieter, dual-slot, triple-fan air-cooler.



Western Digital's Solid Buy

Storage device manufacturer Western Digital announced in March that it would inject $51 million into Skyera, a company that specializes in enterprise solid-state drives (SSDs)—the kind that go in server racks and data centers. This sizable investment of ducats will include "joint technology development," according to the press release. WD was also an initial investor in Skyera when it was founded in 2010.

WD, Seagate, and Toshiba have largely stuck with mechanical drives (and "hybrid" drives that integrate a small SSD for caching), leaving companies like Corsair, Samsung, and OCZ to fight it out in the consumer SSD market. Although WD is apparently sticking to the business sector with this Skyera deal, the long-term implications are intriguing. **–TM**

RIP Google Reader

Google is doing a bit of spring cleaning, and one of the services it's kicking to the curb is Google Reader, the sultan of search announced in a blog post. Reader is an RSS (Rich Site Summary) service, which is used to browse news feeds in a streamlined way. However, it's recently seen heavy competition from Twitter and Facebook. On July 1, 2013, Google is throwing its service a forced retirement party, letting users export their data and subscriptions with Google Takeout until the fated day arrives.

The last entry in the Google Reader blog, prior to the above announcement, came in October 2011 when Google announced a fresh new design and Google+ sharing. **–PL**



Firefox, Gaming, and Monkeys

Browser makers are notorious for taking great pride in even the slightest improvements in JavaScript performance, since using Java to run a 3D game in a web browser usually incurs a 10–12x performance hit (versus running it on your desktop). But when it comes to Mozilla Firefox's "OdinMonkey" module, most of the hype seems justified. At the Game Developers Conference (GDC) in March, the outfit claimed that it had closed the gap to just a 2x performance hit.

At the conference, Mozilla combined forces with Epic (makers of the Gears of War franchise) to present Unreal Engine 3 running in Firefox (pictured above). Mozilla also announced that Disney, EA, and ZeptoLab will be using this technology to deliver games to mobile devices. **–PC**



Tom Halfhill
Fast Forward

FRETTING ABOUT FINFETS

SOME FOLKS scoffed when I wrote in 2011 that Intel's 22-nanometer tri-gate technology was four to five years ahead of everyone else. Now the fog is clearing, and it appears Intel's lead is indeed that dramatic. The biggest independent chip foundries—including the ones that AMD uses—probably won't reach high-yield production with their similar technology until 2015.

Tri-gate transistors are more commonly known as FinFETs (finned field-effect transistors). Unlike all transistors built into integrated circuits since the 1960s, FinFETs are three-dimensional structures with enlarged gates resembling fins that project above the flat surface of the silicon substrate. Their superior electrical characteristics allow them to run faster than conventional two-dimensional (planar) transistors while using less power. But fabrication is a bitch, especially in the large volumes required for mass-market processors.

AMD currently outsources chip manufacturing to two independent foundries: GlobalFoundries (an AMD spin-off company) and TSMC (a popular Taiwanese company). GlobalFoundries plans to introduce FinFETs in its 14-nanometer process (14nm XM). So-called "risk production" starts this year, but high-yield "full production" isn't expected before mid-2015. TSMC plans to introduce FinFETs in its 16nm process (CLN16FF), which is on a similar schedule.

However, both processes are built on previous-generation 20nm technology that is comparable to Intel's 22nm technology from 2011. Consequently, the transistors may not shrink as much as Moore's Law predicts (50 percent every two years). From preliminary data I've seen, the shrinkage could be as little as 3 percent. And by 2015, Intel's second-generation 14nm FinFETs will be in production, so the independent foundries will remain years behind.

Clearly, Intel's kick-ass transistors caught the industry off-guard in 2011. Although researchers have been experimenting with FinFETs for many years, high-yield mass production is much harder than building test chips. Unless Intel stumbles, the competition will keep struggling to catch up.

Tom Halfhill was formerly a senior editor for *Byte* magazine and is now an analyst for *Microprocessor Report*.



Thomas McDonald
Game Theory

BIOSHOCKED BY CYNICISM

THOSE WONDERING if Irrational Games could follow up the original BioShock with something equally engrossing, thoughtful, and entertaining need not have worried. BioShock Infinite is a masterwork of game design and world building. It carries the gameplay elements of the original into a strikingly designed, brilliantly imagined game world. It takes on race, religion, patriotism, nationalism, history, and American identity with an alarming boldness.

The sheer skill with which the game is executed makes its catastrophic failure in the end all the more disappointing. Please note: I say "disappointing," not "offensive" or "wrong," because although I find it both offensive and wrong, that's not my problem. I don't mind being offended and I don't care if games don't share my perspective.

What bothers me is when creative people with the talent of Ken Levine and his team betray their own creation. BS Infinite is shot through with an ugly vein of corrosive cynicism that is only redeemed by the shining and noble figure of Elizabeth, who acts as the light in the darkness. In a pointless and dramatically nonsensical scene, we learn that even she is capable of great evil, given certain circumstances, thus hollowing out the moral center of the game. It's a dramatic failure echoed in an utterly inconsistent and remorseless act of patricide at the end.

Unlike the original BioShock, Infinite abandons any real gamer choice to arrive at its morally muddled end. There is no option between a good ending filled with hope and love and a bad ending filled with misery. There's only misery. In a final act of betrayal, Infinite mocks Christian notions of forgiveness and redemption by suggesting one can either be unforgiven and miserable, or forgiven and psychotic. Its use of the sacrament of baptism to make this point is not merely deeply offensive, but a dramatic cheat that robs the gamer of choice at a pivotal dramatic moment. Does this ruin the whole game? Of course not, but it leaves a bitter taste, and the lingering thought, "What was the point?"

You can follow Thomas McDonald on Twitter: @StateOfPlayBlog.

AMD Sells Austin HQ

Advanced Micro Devices (AMD) this week entered in an agreement to sell and lease back its Lone Star Campus located in Austin, Texas. The new owner will be 7171 Southwest Parkway Holdings, LP, an affiliate of real estate investment company Spear Street Capital. AMD says the sale is expected to generate $164 million in cash, the proceeds of which will be reflected in the chip designer's Q1 financial statement.

This isn't a new strategy for AMD. The company did the same thing with its headquarters in Sunnyvale, California, back in 1998. More recently (2008), AMD sold and leased back its major site in Markham, Ontario, Canada, and will attempt to do the same with its Building 3 property in Austin, Texas. **–PL**

Belkin Nabs Linksys



Belkin announced in March that it had finalized its purchase of the Linksys brand from Cisco, an enterprise networking manufacturer that seems utterly determined to exit the consumer hardware market as quickly as possible. Consolidation in this low-margin hardware market was inevitable, but Linksys will continue to honor outstanding warranties. Belkin cited Smart Wi-Fi, a remote-network management tool available on desktop and mobile devices, as one of the reasons for its acquisition.

Belkin says it plans to maintain the two brands separately and even introduce new products under the Linksys banner. However, the groups will combine their research and development divisions. **–JK**

Tech Tragedies and Triumphs

A monthly snapshot of what's up and down in tech

TRIUMPHS

AMD
Finally announces HD 7990, could finally claim top-GPU honors.

WINDOWS 8
Users get free upgrades to Mail, Calendar, and other apps.

PC GAMERS
Logitech renews its vows to the PC faithful with new line of gaming gear.

SEAGATE
Company is first to market with fat 1TB platters.

TRAGEDIES

EA
After SimCity debacle, and others, its CEO resigns.

LUCAS ARTS
Beleaguered game developer shuttered by Disney.

WINDOWS XP
Reports indicate our BFF OS is slowly losing market share to Windows 8.

WINDOWS RT
Nascent OS sees huge price drops, signals a swan song.

Quinn Norton
Byte Rights

PATENTING MATH

RECENTLY, the Eastern District of Texas—the native habitat of the armadillo, long-tailed weasel, and the patent troll—ruled against a frivolous software-patent suit based on the blindingly obvious fact that you shouldn't be able to patent math. Yet, for more than 40 years, US legislation has allowed the patenting of algorithms as inventions, while the USPTO (United States Patent and Trademark Office) has simultaneously not understood the math—they often issue multiple patents to different people for the same algorithm.

Besides the mind-bending wrongness of staking claim on invention and owning abstract ideas about how the universe functions, software and any given implementation of its math are already grossly overprotected by copyright law. The fact that a program is viciously guarded by the law for more than 90 years, while being obsolete in two-to-five years, is a pile of idiocy. Add to that the more stringent protection of patents—that you can't try to do the same thing for 20 years without a license, even if you thought of it on your own—and the disrespect for basic reality insults the mind.

That's why the main opponents of software patents are programmers, the group that is in theory supposed to benefit. The main proponents are patent trolls, America's 10-billion-dollar industry for preventing people from making things. The European Union, in a moment of blessed, if rare, intellectual property sanity, has shied away from issuing or honoring software patents. Thus they lack America's thriving legal parasite. It's a more welcoming environment for independent software developers, innovative research, and startups, which are increasingly getting smushed by trolls.

Thus far, there's been next to no legislative willingness to fix this problem. Until there is, I can only suggest that France is nice this time of year.

Quinn Norton writes about copyright for Wired News and other publications.

Intel's Haswell Smokes

Intel's next-gen Haswell CPU will feature a huge performance increase trick for processing transparency effects as well as the ability to bypass DirectX for memory access, the company says.

The chip will feature a DX extension called PixelSync that Intel says can perform a transparency task at a 10 percent performance hit, versus a 70 percent hit that the same transparency would take on a $500 GPU. The effect will make smoke, foliage, and water look more realistic on supported titles.

In a demo of Codemaster's upcoming Grid 2, a smoke effect without PixelSync running on a Haswell laptop looked like fog. With PixelSync on, the same fog looked like smoke (pictured). But is it a big deal or just another throwaway tech demo?

"I think it is a big deal for a couple of reasons," says analyst Jon Peddie of Jon Peddie Research. "First, the use of voxels is increasing, especially with computational photography, and second, because Intel is now showing some of its graphics strength. The company has always had the skills [but] just lacked management will to be a serious player in graphics. The graphics in Haswell will be impressive."

Haswell also features the new InstantAccess extension that lets the CPU and GPU share memory and reduce stuttering in games without having to go through DirectX. The company says the API was designed with discrete GPUs in mind, but that isn't the case anymore. The popular free video encoder HandBrake will also be supporting Intel's QuickSync in a future version. **–GU**



Adobe Unboxes Its Products

In March, Adobe told tech website TechHive that it would be phasing out boxed copies of its Creative Suite and Acrobat products. The Suite customarily includes Photoshop, Premiere, Illustrator, and InDesign (though there are several variants for different budgets, kind of like Pokémon). As before, you can still buy downloadable versions from Adobe.com or authorized third parties.

There's also "Creative Cloud," Adobe's subscription-based service. Launched in May 2012, it grants access to Adobe's entire range of products for $50 a month if you make a one-year commitment, or you can pay $75 for month-to-month access. You can subscribe to individual programs for $20 a month with a one-year commitment, or $30 month-to-month. **–TM**

Scanning the Whole Internet

Tech news site Ars Technica reported in March that a single individual had created a network of more than 400,000 computers to scan the entire Internet for security vulnerabilities. The network was so large because the scanner created a copy of itself on the devices that it could access—like a virus. By the time the three-month experiment concluded in mid-2012, the network had generated 4 trillion port scans and gathered over 9TB of data. The researcher (who chose relative anonymity because his scanning experiment probably broke multiple international laws) concluded that embedded devices (modems, network routers, media streamers) were by far the most vulnerable. –TM

THE LIST

THE 6 MOST IMPRESSIVE INDIE GAMES AT PAX EAST 2013



6

DON'T STARVE

The goal of Don't Starve is to live off resources to prolong your life as long as you can. Considering you're going to die no matter what, it's a morbid kind of fun.



5

TRANSISTOR

That this game is from the makers of the amazing Bastion RPG is reason enough to get excited. Its sci-fi dystopian setting and unique turn-based battle are icing on the cake!



4

QUADRILATERAL COWBOY

In Quadrilateral Cowboy, you play a hacker who actually has to use MS-DOS and TelNet to unlock doors. It's hardcore and inaccessible, but that's what makes it completely awesome!



3

CONTRAST

This innovative puzzler has players moving in a 3D world, but as soon as light sources are adjusted to create pathways in the environment, Contrast switches perspectives and becomes a 2D platformer.



2

OUTLAST

Taking place in an abandoned asylum, Outlast is proof that a big budget isn't necessary to create a survival-horror game that will scare the bejesus out of you.



1

DIVEKICK

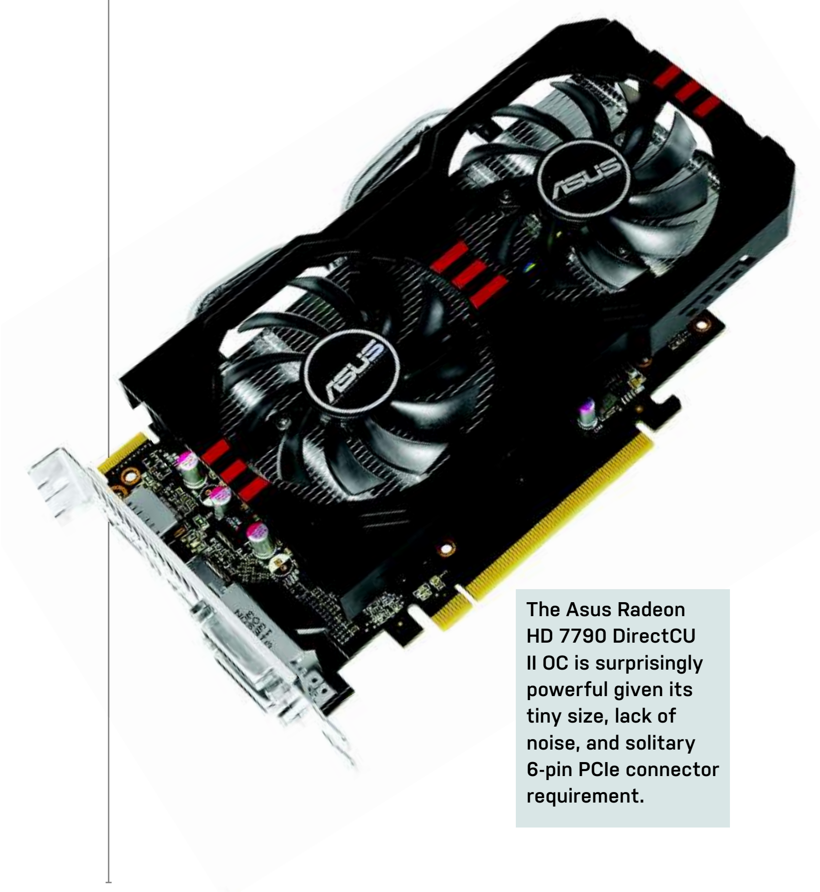
This hilarious fighting-game parody features only one move: the divekick. Quick reflexes are key because landing just one of these comical attacks is all that's needed to win.

HEAD TO HEAD

BY JOSH NOREM

Asus Radeon HD 7790 vs. EVGA GTX 650 Ti Boost

We don't pay too much attention to the sub-$200 GPU market, but this month both AMD and Nvidia announced new boards at around the $150 mark that offer features previously only found on more expensive GPUs, including multi-GPU support and GPU clock boosting (for Nvidia). These new features suddenly made these budget boards *very* interesting, especially when dual-card setups are taken into consideration. Naturally, we pitted the new cards against one another in a Sweet-Spot showdown.



The Asus Radeon HD 7790 DirectCU II OC is surprisingly powerful given its tiny size, lack of noise, and solitary 6-pin PCIe connector requirement.

Round 1: Specs

On paper, both 28nm cards are extremely similar, though the Nvidia card has a few small advantages. First, the AMD card is only available in 1GB flavors; the Nvidia card comes in both 1GB and 2GB varieties, and features a wider 192-bit memory interface compared to the 7790's 128-bit channel. The AMD card offers more stream processors at 896 compared to the 650 Ti Boost's 768 CUDA cores, though this isn't an apples-to-apples comparison. For clock speeds, the Nvidia card can hit a higher speed when boosting, 1,137MHz compared to the AMD card's 1,075MHz clocks, but 60MHz isn't anything to write home about. Both cards support dual-GPU configs (previously unheard of at this price), so that's a draw. The AMD card draws a lot less power, though—just 85W compared to the Nvidia's semi-high 134W.

Winner: Tie

Round 2: Performance

In this category there is a clear winner, and it's Nvidia in both single- and dual-card configs. In every benchmark test we ran except for one, the Nvidia card either had a small advantage or the two cards were neck-and-neck, but at no time did AMD have the upper hand. The one exception was in Dirt: Showdown, which is known to be an AMD game, just like Batman: Arkham Asylum is an Nvidia title. Overall, though, the balance is clearly in Nvidia's favor, with it eking out a small advantage in each test, wiping out any advantage AMD hoped it would gain over Nvidia with the launch of this card. To be fair, AMD originally launched this card against the older GTX 650 Ti, and then Nvidia launched the updated Boost version a few days later in response, so AMD probably wasn't prepared for the response from Nvidia on this one.

Winner: EVGA GTX 650 Ti Boost

HEAD



EVGA's GeForce GTX 650 Ti Boost SuperClocked is the alpha-male version of this card, overclocked and stuffed with 2GB of RAM.

Round 3: Features

Let's examine connectivity first. Both cards offer the same number and type of ports: dual-DVI ports, DisplayPort, and an HDMI port. Second, the Asus bundle includes a CrossFireX cable, VGA-to-DVI adapter, and the Asus DirectCU II cooler, which is one of the best available when it comes to silent operation and great temps. The feather in the HD 7790's cap is the inclusion of a copy of BioShock Infinite—a $60 value and an excellent triple-A title. The EVGA/Nvidia card uses a stock blower-type cooler, which is not sexy, but does the job. The EVGA card also includes a bare-bones bundle that includes a single VGA-to-DVI adapter, driver disk, and a sticker. Both cards ship with superb software, and Nvidia includes $75 worth of in-game money for Hawken, World of Tanks, and PlanetSide 2, which is weak.

Winner: Asus HD 7790

Round 4: Heat and Noise

Just as the Nvidia card has a small advantage when it comes to performance, AMD and Asus have the advantage in this category. First off, the TDP for the HD 7790 is a low 85W, which compares to 134W of the Nvidia card, making AMD the clear winner in terms of power draw. Second, we've seen the Asus DirectCU II cooler keep an overclocked GTX 680 totally silent, so you can image what a smaller version of the cooler is capable of with a low-TDP card like the HD 7790. The AMD card is also able to more efficiently manage its power states compared to previous cards, helping it stay totally silent all the time. Now, we're not saying the EVGA card is loud, but it made a bit more noise in testing than the Asus card, and draws more power, making this category a slam-dunk for AMD/Asus.

Winner: Asus HD 7990

Round 5: Price and Value

This is another round that is easy to decide, because at press time the Asus card was priced at $149 with the copy of BioShock Infinite, and the EVGA card was priced at $179 on Newegg with the $75 of in-game credits. Obviously, the Nvidia card has a speed advantage, and double the memory, but for gamers who are playing at 1080p, the Asus card is totally adequate, so we think it offers a better value given how close the two cards are in every other aspect. Also, the Nvidia card is priced the same as the more expensive Radeon HD 7850, which offers better performance in every test that we use, making the GeForce card seem kind of expensive in comparison. There is a 1GB version of the 650 Ti Boost that costs $149, which is more compelling than this version, in our opinion.

Winner: Asus HD 7790

And the Winner Is…

There is a clear winner at this $150-ish price point, and that's the **Asus DirectCU II Radeon HD 7790**. The Nvidia card would be extremely competitive at $150, but not at $170, where it's just a bit too expensive and unable to compete with the Radeon HD 7850. AMD's inclusion of BioShock Infinite really sweetens the pot, too, making it an amazing deal at $149 since it includes the superbly silent DirectCU II cooler and always-excellent Asus engineering.

DOCTOR

THIS MONTH THE DOCTOR TACKLES...

> Overheating CPUs
> Caseless Computing
> SSD Free Space

The Cooler Does Nothing!

I have a PC I built in 2011 with an Asus P8P67 motherboard, EVGA GTX 570 GPU, 3.4GHz Intel Core i7-2600K CPU, and Cooler Master Hyper 212 Evo cooler. When playing BF3, I consistently get temps around 90 degrees Celsius. I'm pretty sure this is dangerous territory, though I've never had any problems—no crashes or anything.

Still, this morning I took my cooler off and reapplied the thermal paste. I added a pea-size drop of Arctic Silver 5 after thoroughly cleaning both the chip and the cooler. I plugged everything back up and got the same result. I have an older Lian Li case that has decent cooling. If I take the door off the machine it's very loud, but it does drop the temp by about 10 degrees. Still, 80 degrees seems too high. Friends who play with me who have the same basic setup see temps more like 50 C and 60 C at load. My idle temp is around 40 C.

What am I doing wrong? What should I try? Should I worry about it or is 90 C OK?

—Aaron Newton

THE DOCTOR RESPONDS: Yikes, that is high. The Doc used to have the same problem: a high-powered cooler that just wasn't doing the job. The culprit? The PC's case. It had zero intake fans. It sounds like you're not getting enough airflow through your PC—or your CPU fan is fighting with your exhaust fan. Without a fresh supply of cool air and a quick way to exhaust the warm air, the ambient temp in your case is going to stay high, and even a great cooler isn't going to keep your rig cool. Check that your intakes are clean and free of dust, your fans are spinning, and you have clear airflow from your front intakes to your rear exhaust fans. If you have fan mounts that aren't occupied, consider getting some high-airflow fans to put in them. If that doesn't help, it may be time to invest in a new case—one that has ample cooling for today's components. Finally, make sure the utility you're using is modern and reports the chip temps correctly. CPUID.com's HW Monitor works very well and will let you log the temps. The Doc also recommends using Intel's own Turbo Boost Monitor to see what your chip is spooling up to, as well. A chip that's stable but excessively hot may not actually boost as high as it would if it were cooler.



HighSpeed PC's Tech Station gives you stylish open-air computing.

Airplane Mode Shortcut

I loved the airplane mode tip for Windows 8 in the April 2013 issue (How To). It reminds me of the keyboard key on my mother's laptop, which will enable/disable network access with the press of a button. Can you set me up with a shortcut that I can place in my Windows 8, Windows 7, Windows XP system tray or desktop what will accomplish the same thing?

—Robert Cichon

THE DOCTOR RESPONDS: You're not the only one asking for this, Robert—our research shows plenty of people around the web asking the same thing. Unfortunately, there doesn't seem to be a simple way to do it other than the way we've already talked about. Microsoft declines to make that API call available to outside developers, and if someone has figured out how to do it, we don't know of it. As for the alternative methods, those work by powering the radios on and off via hardware; Microsoft says the software airplane mode is the way to go, because it prevents other programs from turning those radios back on without your permission.

The Emperor Has No Case

What is your opinion on putting together a rig without a

↘ submit your questions to: doctor@maximumpc.com

case? I think it's rather cool to have a "visible" computer. However, I am concerned about heat dissipation. The system only has a CPU fan and nothing else. Is the natural convection adequate to cool the system?

—Bill Ryder

THE DOCTOR RESPONDS: We run open-air test benches all the time in the Lab, Bill (ours are from HighSpeedPC.com). We still recommend having some sort of framework to affix your components to, just so everything stays connected. There are plenty of PC "test bench" cases that provide the sort of look you seem to be going for. A closed case does provide focused airflow, as well as protection for your parts. But as long as the room your PC is in has decent climate control, natural convection ought to be enough, though you may want to add an additional fan to keep air flowing over the motherboard components. Just make sure you keep liquids, pets, small children, and airborne debris away. And don't come crying to the Doc if something happens.

CPU Out of Gas?

I have an older laptop with a Pentium III 750 running Windows XP. I had been using it just for Internet browsing until it started to slow down. It was taking forever to boot and opening any application became excruciating. I thought it may have been a virus or just crapware that I might have installed inadvertently, so I wiped the drive and did a fresh install of Windows XP. It didn't make much difference in speed so it made me wonder about the hardware, specifically the CPU. Do CPUs slow down over time and eventually stop working? I was always under the assumption that they either work or they don't.

—Greg Whitlock

THE DOCTOR RESPONDS: If you're getting poor performance even after a clean install, it is more likely to be caused by a hardware problem than an OS issue. However, make sure that you're not infecting the machine immediately after your clean install. The Doctor has seen a person perform a clean install on a box to eliminate a malware issue and then immediately get it infected upon connecting to the Internet. Despite its age, Windows XP continues to be a top target of malware and putting an unpatched XP box on the Internet without a firewall can result in nearly instantaneous infection. If your outbreak was severe enough, it may have infected any portable drives you use, so you could be getting re-infected that way.

But assuming that your issue is purely hardware, CPUs don't get slower over time. They will execute the code as fast in 2013 as they did in 2001—it's just that the code of 2013, written for more powerful hardware, may be far more taxing than the code of a decade ago. There are two problems the Doc thinks might be responsible. The first is possible CPU throttling due to heat. The PIII doesn't have the advanced onboard thermal throttling of today's Core i7 chips. Instead the chip counts on the chipset and motherboard to throttle back the clocks. If the laptop's fan is filled with dust or failed, the CPU may be throttling back in speed. The other possible issue is a failing hard drive, which may be generating enough random errors to affect performance.

Don't Delete Your SSD?

In the April issue the Doctor told us how to move items off an SSD to regain space. Doc, I know I read somewhere that deleting files from an SSD doesn't work the same as a delete from, well, the other type of hard drives, that the more files are deleted, the worse the SSD performs. Is that so? I have avoided performing a lot of deletes on that drive, but no doubt things happen just from running the system.

If the drive has been filled up that extensively, will a simple delete be much of an improvement?

—Leslie P.

THE DOCTOR RESPONDS: It's true that deleting files from an SSD doesn't work in quite the same way as deleting them from a hard drive, but it's not true (anymore) that your SSD will perform worse the more files you delete.

The flash memory in an SSD consists of 4KB "pages" inside larger "blocks" (usually 512KB). Because of the way flash memory works, you can read individual pages, and write to them if they're empty, but you can only empty a page by deleting the whole block, then rewriting the pages of the block you aren't deleting. Deleting files in your OS only marks the pages they're on as able to be erased, but the data isn't actually gone until the next time the drive needs to write to that block. Then it's erased and overwritten with new data.

On older SSDs, that meant that, once the drive ran out of blocks that had never had data on them, it had to start putting files on blocks that contained data previously marked for deletion. Instead of just writing the data to the block, the SSD first had to copy the whole block to its cache, erase the information marked for deletion, replace it with the new information it needed to write, clear the entire block, then rewrite it with the old good data and the new data. This is a lot more work than just writing the information to a fresh block, so the SSD would slow down by a huge margin while doing all this extra work.

Fortunately for us, that's not something you really need to worry about anymore. All modern SSDs have garbage collection algorithms in their firmware, as well support for the Trim command (see our Holiday 2009 white paper at http://bit.ly/7GhVfo). These nifty tools work while your PC is idle to clear away data marked for deletion and optimize data on those blocks. Windows 8 will even detect if you have an SSD and let you manually invoke the Trim command.

So while nearly full drives can still get clogged up in the manner described above, even after deleting a bunch of data, simply leaving your computer on and not doing anything for an hour or so is enough to get your SSD back up to speed.

[SECOND OPINION]

Moving Personal Files

I read your response to Paul Lamb regarding relocating personal files (April 2013). There is an easier way to do this:

1. Create a folder on the hard drive named \Users\<user name>.

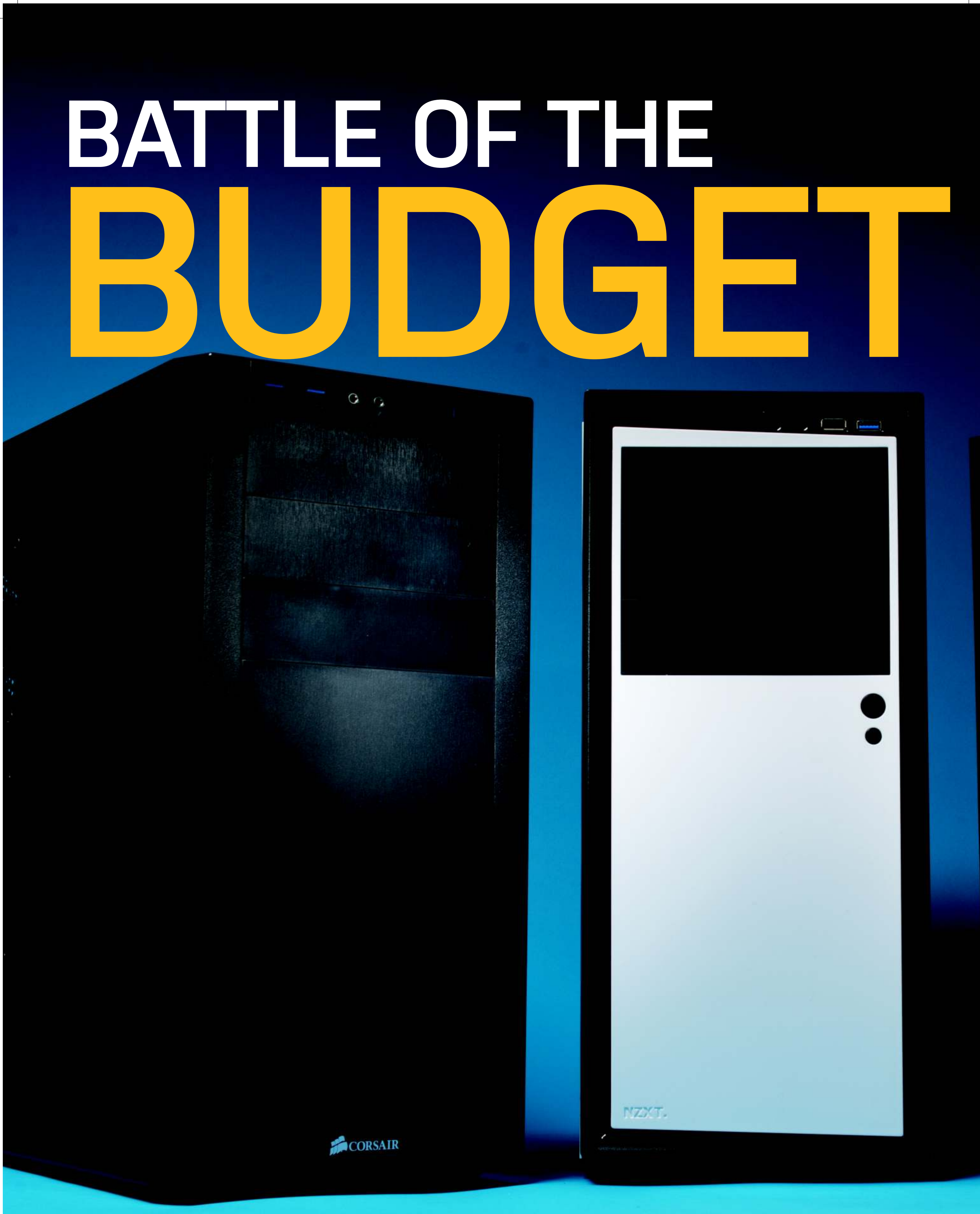
2. Navigate to the SSD system drive's \Users\<user name>, where you will find all of the personal folders.

3. Right-click each folder, including the Desktop, and select Properties. Click the Location tab and change the drive letter of the folder location to the hard drive. Click OK, and answer "yes" to the questions about creating the new folder and moving the files.

At that point, all of the personal files will reside on the hard drive and the space they took will be freed from the SSD.

—Rich Scholl

BATTLE OF THE BUDGET



WILL THE BEST $750 PC PLEASE STAND UP

BY GORDON MAH UNG, TOM MCNAMARA, AND CHRIS ZELE

BUILDS



We've always said that building on a budget takes far more skill and savvy than building without financial constraints. Every single component choice has to be carefully weighed for its potential benefits and drawbacks. As if that weren't enough, budget builders have to decide between three prospective platforms: Intel's LGA1155, and AMD's AM3+ and FM2. With so many permutations possible, and so much room for error, a cash-strapped builder's got to wonder which thrifty path offers the best all-around performance. We can think of no better way to answer this important question than with a down-and-dirty DIY dust-up.

Yes, we set three staffers loose in the Lab to battle it out build-it style. For ground rules, each was assigned one of the three competing platforms and given a hard limit of $750. Since prices shift from day to day, or even hour to hour, all of the competing configurations were priced with the popular PCPartPicker.com tool and the specs were all finalized at 6:00 p.m. of the same day. Since rebates also change daily, they weren't factored into the total cost.

Editors were allowed the freedom of using personal knowledge and the Internets to inform their picks, but since many of the components used in these builds aren't typically on our "enthusiast" radar, none of the editors really knew for certain if one part was faster than another. And like most buyers screwing together parts from a shopping list, they didn't know if everything would actually work together in the end, either.

You must be dying to know how this all plays out, how the builds perform in the benchmarks against each other as well as against our house Budget box (Blueprint), and which of the budget builds gets the ultimate nod from our panel of judges.

The contestants have their tools drawn, so let the battle begin!


Senior Intern **Chris Zele**

FM2 Build: Choose Your Battle

Can a GTX 670 ride this rig all the way to victory?

MY PLAN

I was given the task of creating an AMD FM2 system, so my initial plan was to build a hybrid CrossFire AMD A10-5800K box, leveraging the integrated graphics to assist a discrete GPU in graphics chores. I planned to use the quad-core part coupled with a Radeon HD 6670 and overclock them both. That whole plan went out the window, though, when I learned that Tom and Gordon were going to use GPUs that were far faster than a hybrid CrossFire setup. I had to zig instead of zag, so I decided to go for broke on the graphics side, spending half my budget on the GPU. I had to rob Peter to pay Paul, so my quad-core A10-5800K was swapped out for a dual-core A6-5400K. This might seem foolish, but it was a calculated risk. Both of my competitors have CPU platforms with chip options far faster than FM2. The Piledriver cores in FM2 CPUs can't really compete with six-core FX chips or any LGA1155 quad part, so I conceded the CPU tests. I figured that if I was going to lose in CPU benchmarks I may as well try to win all of the GPU benchmarks. I just hoped that the A6-5400K I selected wouldn't hold back the video card's performance too much.

After Gordon saw my build, he dubbed it the "Scud Missile," as it had a bunch of low-end parts flanked by a kick-ass GPU.

PARTS LIST

CPU	AMD 3.8GHz A6-5400K	www.amd.com	**$75**
Motherboard	MSI FM2-A55M-E33	www.msi.com	**$49**
RAM	Kingston Black 8GB/1600	www.kingston.com	**$37**
HDD	HGST 500GB	www.hgst.com	**$55**
GPU	MSI N670GTX-PM2D2GD5/OC	www.msi.com	**$349**
Case	Corsair 200R	www.corsair.com	**$50**
PSU	Corsair CX430	www.corsair.com	**$45**
OS	Windows 8	www.microsoft.com	**$90**
Total			**$750**

THE CPU AND COOLER

This is a category where FM2 can be easily outclassed by the other two sockets. On the AM3+ build, Tom could scale all the way up to eight cores. And since both the FM2 and AM3+ parts use the same Piledriver cores on the latest CPUs, there's just no way to beat the FX-6300 CPU in Tom's rig. I knew if I wanted to win any of the benchmark rounds I would have to downgrade my CPU to a dual-core A6 5400K. I considered an overclock but settled on the stock cooler. The best part is it's free and I saw no point in overclocking my wimpy dual-core—it still wouldn't win any computing chores. The AMD 5400K comes with a stock clock of 3.6GHz and a Turbo Boost of 3.8GHz, which I thought would be more than enough for some of our GPU-heavy benchmarks.

THE MOTHERBOARD

Despite its budget persona, the FM2 platform actually offers some very nicely outfitted dual-GPU motherboards. My build, though, would have none of that. I wanted to save money for my other parts, which is why I picked a budget microATX board: MSI's FM2-A55M-E33. The inexpensive mobo comes with four SATA ports, one x16 PCIe slot, and four USB 2.0 ports. Yup, no USB 3.0. The board has two DIMM slots but they support up to 16GB of DDR3/1866. It may be basic, but at least it's only $49.

RAM

My FM2 box needed to make up ground wherever possible, so as a result, I went with a pair of Kingston Black 4GB DDR3/1600 modules for $37. I hoped that by having slightly faster RAM and more of it I would get a small edge in performance against Gordon and Tom, as they both chose lesser amounts of 1,333MHz RAM. Tom's box is even running in single-channel mode, too.

THE GPU

After Tom and Gordon revealed their respective plans for the beefier Radeon HD 7870 and GeForce GTX 660 boards, I knew I had to get something that would trounce them in performance. I decided to go with a GeForce GTX 670 from MSI, which would easily outperform the GPUs they selected. With a strong GPU to counter-balance my low-end processor, my goal was to win out on the gaming benchmarks, as half of the benchmarks we chose to determine performance were GPU-based.

THE CASE

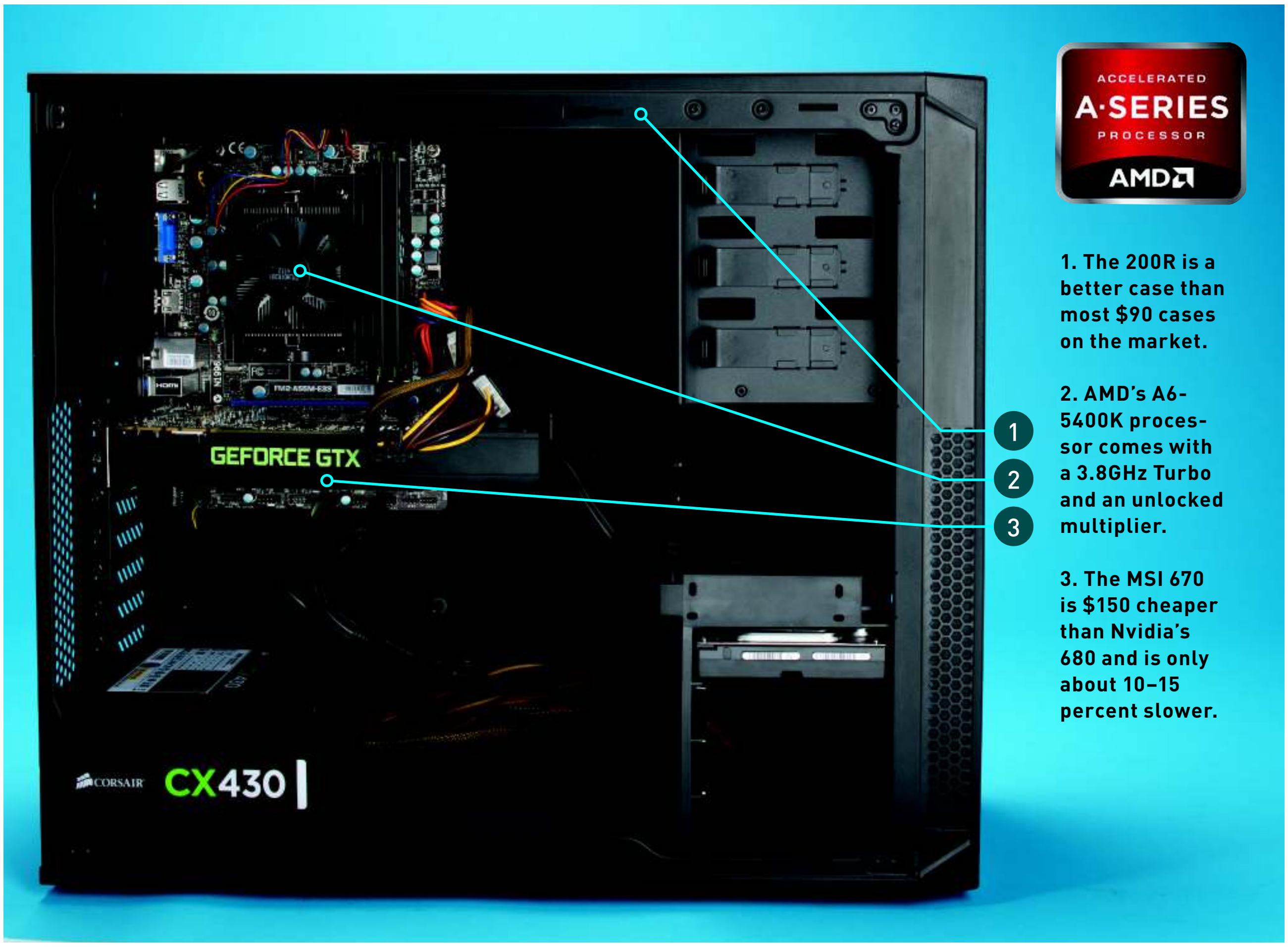
For my case, I wanted something that would give me tool-less drive bays, cable-routing accommodations, and a clean design, all for $50. As luck would have it, the Corsair 200R was on sale for that price. The 200R offers everything I was after, plus sports two fans along with front-panel USB 3.0 ports. Sadly, my mobo doesn't support USB 3.0, but I could still make use of the ports using the USB 2.0–to–USB 3.0 adapter that came with the case.

THE STORAGE

My primary storage for this build was a HGST 7,200rpm 500GB mechanical hard drive. I decided to forgo an SSD because it would blow out my budget. I also figured an SSD wasn't imperative with Windows 8, which is very quick and responsive even on mechanical hard drives.

THE PSU

Like Gordon, I gambled a little on my PSU choice. The GeForce GTX 670 needs dual 6-pin connectors to power up. As my Corsair CX430 V2 has only one 6-pin, I had to use a Molex-to-6-pin adapter to power my GPU, and I wasn't



1. The 200R is a better case than most $90 cases on the market.

2. AMD's A6-5400K processor comes with a 3.8GHz Turbo and an unlocked multiplier.

3. The MSI 670 is $150 cheaper than Nvidia's 680 and is only about 10–15 percent slower.

100 percent certain it would work. Luckily for me, it did, and I had no problems using the adapter.

Yes, I took a chance with the PSU, but not like Gordon who opted for a "free" PSU with a warranty period shorter than the expiration of a gallon of milk—30 days. That doesn't exactly inspire confidence. My CX430 V2 does, though. It has a 3-year warranty and I'm pretty certain it'll handle the 170-watt needs of the MSI GTX 670 card.

THE BENCHMARKS

Despite my best efforts, my rig got the crap kicked out of it in the benchmarks. It was like a ragdoll being ripped to shreds by rabid pit bulls. Yeah, not pretty. And I'm not just talking about the two other builds in this competition, either. The A6-5400K couldn't even hang in some CPU-bound tests with the Phenom II X4 965 from our Budget Blueprint. But hey, we're talking a dual-core with shared resources versus a quad-core with four actual separate cores. What's interesting is how much better the Piledriver cores are over the Phenom II in some encoding tests. The little A6-5400K actually beat the Phenom II X4 in ProShow Producer, which is optimized for four threads. (Encoding has long been a weakness in the old Phenom II.) I'm also surprised the A6 did as well against the Phenom II 965 in Stitch.Efx 2.0 and x264 encoding. The results may look ugly, but remember, it's only a dual-core and it even shares resources, too.

In gaming, the GeForce GTX 670 easily made mincemeat pie out of the Radeon HD 7770 card in the Budget build, but that's to be expected. Unfortunately, that card didn't give me the advantage I was counting on against Tom and Gordon's builds.

BENCHMARKS

	ZERO-POINT	
Stitch.Efx 2.0 (sec)	1,813	2,665 (-32%)
ProShow Producer 5.0 (sec)	3,127	2,973
x264 HD 5.0 (fps)	8	3.5 (-56%)
STALKER: CoP (fps)	29.9	58.1
Hitman: Absolution (fps)	14	19.1
3DMark 11 Performance	3,983	4,096

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our current Budget build uses a Phenom II X4 965 BE, a Gigabyte GA-970A-UD3, 4GB of DDR3/1333, an Asus Radeon HD 7770, a 120GB Samsung 840, and WD Caviar Blue 1TB HDD. All tests were run on Windows 8.



Associate Editor **Tom McNamara**

AM3+ Build: A Hex on the Competition

Made from parts you'd actually want to buy

MY PLAN

Intel's Ivy Bridge provides a lot of value, but I thought we needed an AMD system to keep things interesting. I could have just dropped in a Phenom II X4 965 for $100, but I can have intelligible conversations with people who are younger than that CPU. I managed to wedge in an FX-6300, which is based on AMD's newer Vishera microarchitecture. Combine it with a Cooler Master Hyper 212 Evo cooler and an ASRock 970 Extreme3 motherboard, and we should have some overclocking headroom to shorten the distance between this chip and Gordon's quad-core Intel system. I briefly considered jamming in an eight-core FX-8320, but I would have had to make some ugly sacrifices. My goal was to build a respectable machine that a person might want to buy, made of parts with a greater reputation for reliability. I'll leave it to my competition to strap a rocket to a roller skate, even if it means losing on a few benchmarks.

THE CPU AND COOLER

The FX-6300 is officially a hexa-core CPU, although its cores share three floating-point units when the conventional math would, well, call for six of them. At stock, it runs at 3.5GHz, but its microarchitecture is different enough from Intel's (and even the Phenom II) that you can't make direct comparisons. Either way, it's a very solid unit for the price, and pairing it with a Cooler Master Hyper 212 Evo allows me to overclock to 4GHz easily, so it's worth the extra expense.

Sure, I could have spent that $30 or so on an optical drive or another 4GB of RAM, but I also wanted a system that would not sound too loud under load. 4GB is a fine starting point for a general-purpose system. And once your system is installed, it's a heck of a lot easier to snap in another stick of RAM than it is to replace a stock CPU cooler. It would also be a shame to yoke a nice CPU and motherboard to a stock heatsink. And unlike the Phenom II 965, FX chips have support for AVX and FMA calculations, so they'll be better at stuff that requires lots of floating-point operations.

PARTS LIST

CPU	AMD 3.5GHz FX-6300	www.amd.com	$130
Cooler	Cooler Master Hyper 212 Evo	www.coolermaster.com	$33
Motherboard	ASRock 970 Extreme3	www.asrock.com	$85
RAM	Kingston Value 4GB DDR3/1333	www.kingston.com	$19
HDD	WD Caviar Blue 500GB	www.wd.com	$55
GPU	MSI Radeon HD 7870 GHz Edition	www.amd.com	$230
Case	NZXT 210 Elite	www.nzxt.com	$50
PSU	Corsair CX500	www.corsair.com	$58
OS	Windows 8	www.microsoft.com	$90
Total			$750

THE MOTHERBOARD

I chose ASRock's 970 Extreme3 primarily for two reasons. One, it's one of the cheapest motherboards you can get that has heatsinks on the voltage regulator modules. This feature is critical for overclocking and recommended for general stability. Two, it has four RAM slots thanks to its full ATX form factor. So although there's 4GB in there now, you can easily have up to 16GB without having to swap anything. And it'll take up to 32GB clocked up to 2,100MHz; both features are actually pretty handy for encoding HD video. Its additional PCI Express Slot, five SATA 6Gb/s ports, eSATA, UEFI BIOS, optical and coaxial audio, and Japanese-manufactured capacitors are just gravy, in my opinion.

THE RAM

Yes, it would have been nice to have 8GB of RAM, or even two 2GB sticks to at least have dual channels. But both options carried a premium that would have busted my budget. Such is the price of including high-quality parts elsewhere. In fact, the day after we ordered our parts, the price of DDR3 began to creep up across the board, so we dodged that bullet. At least I have a common 1,333MHz stick branded by Kingston, so getting a genuinely matching stick later on should not be too difficult.

THE STORAGE

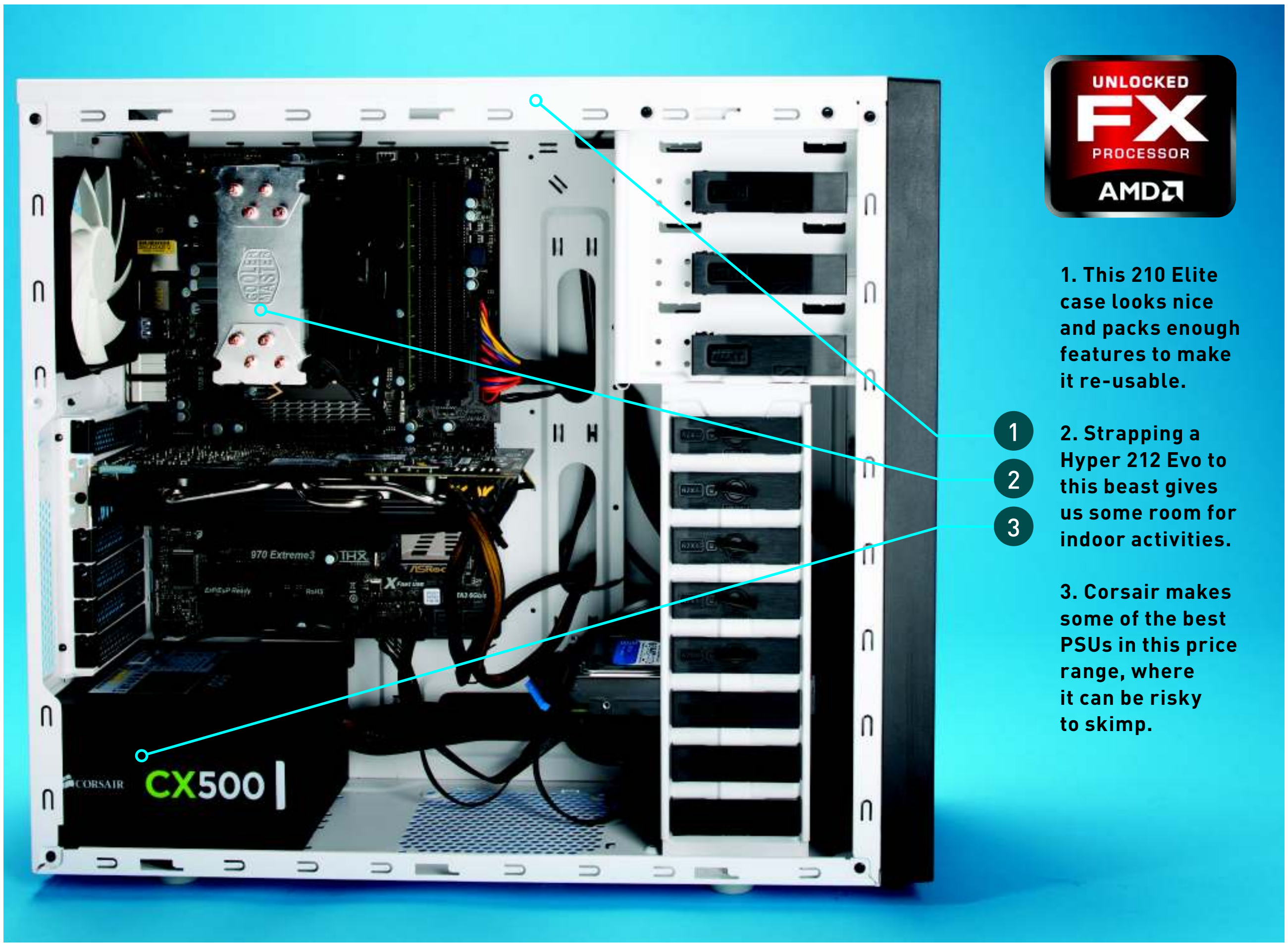
I took the most conservative option here. I thought that an SSD worth buying wasn't really in the cards, and I could do without an optical drive. It's going to cost me some performance, but I was determined to have uniformly recommendable parts in my build. Since Windows can be installed from a USB stick, and there isn't much else that truly requires an optical drive, I didn't feel too bad about my decision, even if it meant having fewer lasers involved.

THE GPU

Since I'd already gone AMD with the CPU, I liked the idea of sticking with the brand for my video card. And the MSI Radeon HD 7870 GHz Edition is no slouch. It will perform roughly the same as Gordon's Nvidia GTX 660. I also overclocked the core to 1,100MHz and the memory to 1,400MHz.

THE CASE

The NZXT 210 Elite has a front USB 3.0 port, lots of room for long video cards, a painted interior, tool-free drive cages, two bundled fans (12cm and 14cm), a bottom PSU mount with external ventila-



1. This 210 Elite case looks nice and packs enough features to make it re-usable.

2. Strapping a Hyper 212 Evo to this beast gives us some room for indoor activities.

3. Corsair makes some of the best PSUs in this price range, where it can be risky to skimp.

tion, and seven fan mounts. It's the kind of product that you can keep between builds, rather than donating it to someone or stowing it in a basement. Being able to use a case like this multiple times offsets its higher cost in the long run. Like the power supply, its benefits will not be reflected in the benchmarks. Like Gordon's caching SSD, it's a thing you have to see and feel firsthand to appreciate. Once you've assembled a computer with a solid case like this one, it's hard to go back to a generic box.

THE PSU

This was the other half of what I sacrificed for. The Corsair CX500 might not be the flashiest unit in its class, but with 80-Plus Bronze efficiency, a single 12-volt rail, two 8-pin PCIe cables, a thermally controlled fan, sleeved cables, and a respectable 3-year warranty, it's also the kind of product you can use with confidence for several years of moderate-to-heavy usage. I would have preferred a modular unit, but the 210 Elite has enough room for me to tuck the extra cables out of the way.

THE BENCHMARKS

The zero-point's Phenom II X4 965 can't keep up with a modern hexa-core CPU. But the Radeon HD 7870 GHz Edition makes by far the biggest difference versus a Radeon HD 7770, with its greater bandwidth, additional video memory and shaders, and higher clock speeds. These two cards are more like cousins than siblings. Overclock the FX-6300 to 4GHz, and the difference in overall system speed becomes even more apparent; we dominate in every game benchmark and rock the multithreaded apps for good measure. The zero-point's Samsung 840 solid-state drive will make the desktop experience feel much snappier overall, but the expense of this storage device clearly doesn't end at the cash register, as that system sacrifices GPU and CPU horsepower to stay within budget.

BENCHMARKS

	ZERO-POINT	
Stitch.Efx 2.0 (sec)	1,813	1,640
ProShow Producer 5.0 (sec)	3,127	1,950
x264 HD 5.01 (fps)	8	11.4
Stalker: CoP (fps)	29.9	54.9
Hitman Absolution (fps)	14	28
3DMark 11 Performance	3,983	6,671

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our current Budget build uses a Phenom II X4 965 BE, a Gigabyte GA-970A-UD3, 4GB of DDR3/1333, an Asus Radeon HD 7770, a 120GB Samsung 840, and WD Caviar Blue 1TB HDD. All tests were run on Windows 8.



Deputy Editor **Gordon Mah Ung**

LGA1155 Build: Quad-Core Curveball

Intel parts can't compete on price, or can they?

PARTS LIST

CPU	Intel 3.1GHz Core i5-3350P	www.intel.com	**$176**
Motherboard	ECS H77H2-M3	www.ecsusa.com	**$65**
RAM	Kingston Value 4GB DDR3/1333	www.kingston.com	**$26**
ODD	Lite-On iHas IHAS 124-04	www.liteonit.com	**$16**
SSD	A-Data Premiere Pro SP600 32GB	www.adata-group.com	**$45**
HDD	WD Caviar Blue 500GB	www.wd.com	**$55**
GPU	Gigabyte GV-N660OC-2GD	www.gigabyte.us	**$216**
Case	Rosewill R218 w/450W PSU	www.rosewill.com	**$61**
OS	Windows 8	www.microsoft.com	**$90**
Total			**$750**

MY PLAN

Once I was assigned with building a budget box around LGA1155, I originally sketched out a sedate dual-core Ivy Bridge machine (Core i3 or Pentium G) using the Corsair Carbide 200R, upgradeable motherboard, and a quality PSU. Yes, the Honda Civic of budget boxes. It gets your computing done in a reliable and boring fashion. In a drag race of budget rigs, though, and up against overclocked FX and A-series chips with more cores, I don't believe a non-overclocking i3 has what it takes. But to even get into an overclocking part for Intel breaks my budget, too, so I figured there was no way LGA1155 could possibly win at $750 with OS. Once I sat down and started running the numbers, though, I decided I didn't want to go down without a fight. And to quote Admiral James Tiberius Kirk, "I don't like to lose."

But would my curveball strategy really upstage the other rigs with their cost advantage, or would I be marooned for an eternity on dead, nonfunctional PC island? In essence, buried alive. Buried alive.

THE CPU AND COOLER

Rather than a predictable dual-core CPU, I decided to bet the farm that a quad-core Ivy Bridge part would give me an advantage over the overclocked A-series and FX chips I expected to face. For that, I turned to the Core i5-3350P. This 22nm CPU is a full-on quad-core Ivy Bridge part. It lacks Hyper-Threading but has a mild Turbo Boost mode. There's a modest overclock available but as a non-K part, it ain't much, and only on Z-series chipsets. The Core i5-3350P graphics core is disabled but it's actually 100MHz faster than the pricier Core i5-3330. Besides the clocks, spec-for-spec it's the same as the Core i5-3570K. The chip comes with a stock cooler that's not horrible, either, with its copper slug.

I think this highlights a weakness in Intel's lineup: There's no unlocked part to be had for less than $200. Ideally, I would have used a modern version of the old Core i5-655K chip.

Could I have sacrificed a couple of the other "luxuries" in the rig to get a Core i5-3570K and cheap cooler, so I could overclock, too? Perhaps, but I thought going that far would seriously compromise the machine beyond actual usefulness.

THE MOTHERBOARD

Besides socket, my motherboard decision was dictated primarily by price and also by chipset selection. As Intel only offers its RST SSD caching (more on that later) on 7-series boards, I knew the minimum I could run is the H77 chipset. There's no top-shelf luxury brand here, either, for my budget. No, it's a basic ECS H77H2-M3 in microATX trim. It's pretty bare-bones with its two DIMM slots and one x16 PCIe slot but at least I get two SATA 6Gb/s ports, and two USB 3.0 ports, plus the SSD caching that will have my mechanical drive hopefully singing like an SSD. ECS isn't a brand too familiar to enthusiasts but it's well known in budget circles. In fact, I turned to ECS back when I gave former editor Dave Murphy a sound thrashing on a budget build challenge in 2007 (read it at: http://bit.ly/a3ipW4).

THE RAM

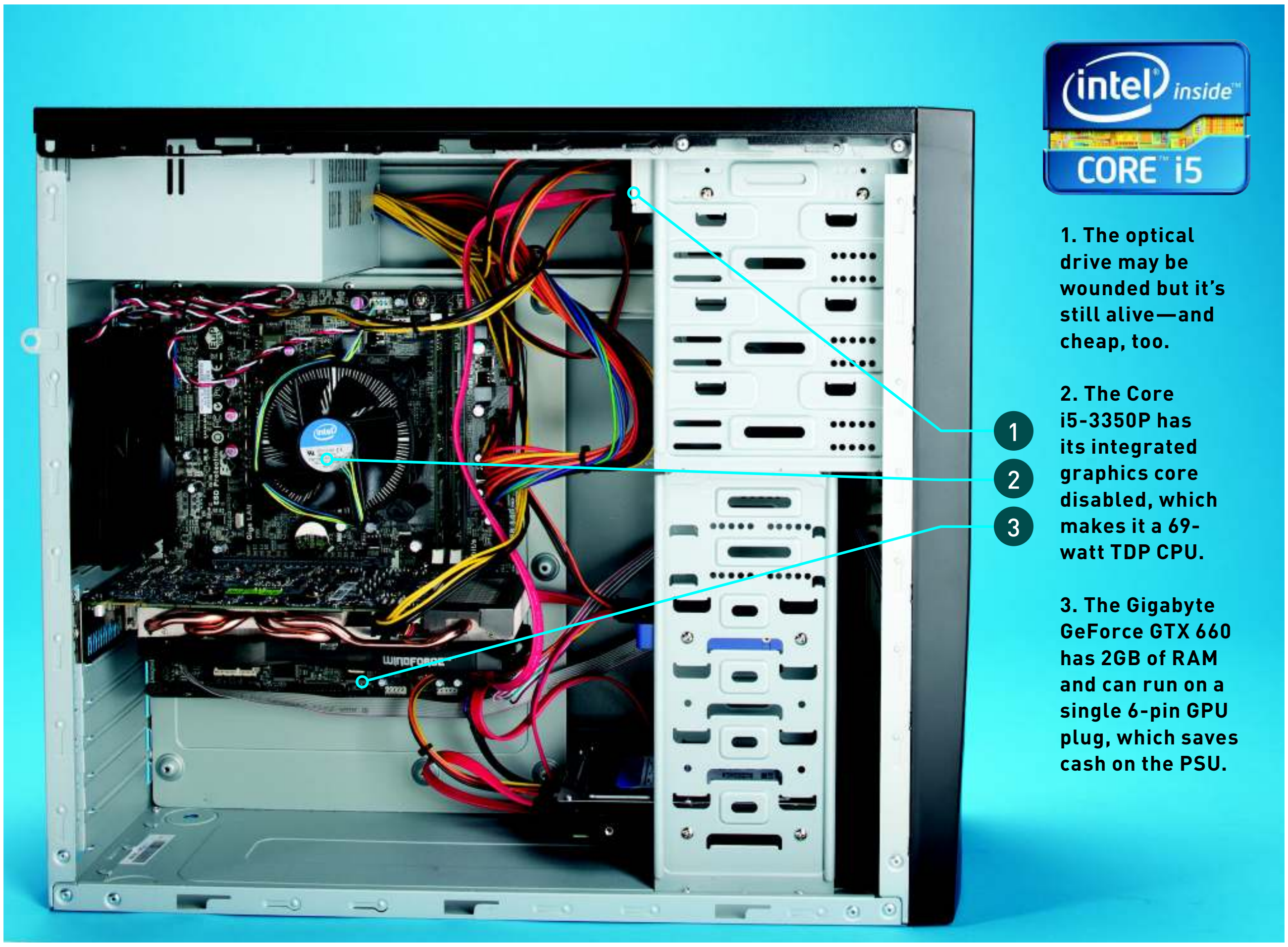
I originally considered running a single 4GB DIMM in single-channel mode to save funds, as few apps are actually bandwidth-sensitive, but I decided that I didn't want to take the hit on any transcoding or encoding tests; so as much as it pains me, I filled the only two DIMM slots with a pair of 2GB Kingston DDR3/1333 modules. I decided 8GB was too pricey and Windows 8 runs fairly nicely on 4GB of RAM.

THE STORAGE

I could have taken the easy way out and stripped out the optical drive and gone mechanical-only. But enough readers have convinced me that the optical is still needed—for now. So $16 went to the Lite-On iHas IHAS 124-04. I also really wanted to give the machine the luxurious feel of an SSD. One way to do that on the cheap is with Intel's Storage Response Technology, aka SSD caching software. It allowed me to pair the cheapest SSD I could find, A-Data's 32GB Premier Pro SP600, with a Western Digital 7,200rpm Caviar Blue 500GB drive. The Premier Pro SP600 is no Samsung 840 Pro, but with sequential reads of about 363MB/s and writes of 136MB/s it should give the rig a peppiness the other boxes won't have.

THE GPU

I originally planned to use a hotter GPU but then realized that I'd not only pay extra for a Radeon HD 7870, but for a fatter PSU, too. Then I really thought about how much of an actual increase in



performance I would see. Maybe 5 to 10 percent? Should I really throw the optical drive and SSD-like feel of my system overboard just to go from 23fps to 28fps in a game? No. In the end, Gigabyte's GeForce GTX 660 OC would fit the bill. The card has the same memory interface as the pricier 660 Ti, 2GB of RAM, and more importantly, it runs on a single PCIe 6-pin power plug.

THE CASE

Rosewill's R218 has long been a means to an end for budget builds. It's not sturdy, doesn't have the latest bells and whistles such as front USB 3.0 ports, but it's low-cost and it comes complete with a 450W PSU. I admit, this enclosure is a compromise, but I'll also say that once it's tucked far enough under my desk and has attracted enough dust, I won't even notice.

THE PSU

The freebie 450W PSU that comes with my R218 case was the biggest gamble. Would it have the cojones to run the GeForce 660 and my quad Ivy Bridge? I didn't know going into this. One thing that does make me feel better is that Rosewill is Newegg's house brand, so technically, recourse is possible if something goes awry.

THE BENCHMARKS

There's no surprises here. You can't put an Ivy Bridge quad-core against an AMD Phenom II X4 965 and expect anything except a total beat-down in anything that's CPU-heavy. The same can be said of the budget Radeon HD 7770 against the GeForce GTX 660. I will say one thing about our current Budget rig, it at least has an optical drive and a luxurious Samsung 840 aboard, which boosts its pleasure factor as well as its performance in disk-heavy tests. I could go on ad nauseum about this benchmark or that, but I'm more concerned about the other two rigs here, not our old budget build.

BENCHMARKS

	ZERO-POINT	
Stitch.Efx 2.0 (sec)	1,813	1,197
ProShow Producer 5.0 (sec)	3,127	1,802
x264 HD 5.0 (fps)	8	10.2
STALKER: CoP (fps)	29.9	57
Hitman: Absolution (fps)	14	23.4
3DMark 11 Performance	3,983	6,148

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our current Budget build uses a Phenom II X4 965 BE, a Gigabyte GA-970A-UD3, 4GB of DDR3/1333, an Asus Radeon HD 7770, a 120GB Samsung 840, and WD Caviar Blue 1TB HDD. All tests were run on Windows 8.

The Closing Arguments

Each editor makes a final case for his config







FM2: GPU FTW

My system might be unbalanced, but it has the video chops to do every GPU task imaginable.

Members of the *Maximum PC* court, let me start by stating that almost everything that a PC enthusiast does on his or her desktop uses the GPU in one way or another—from using multiple monitors to gaming. If you set your video encode to run on the GPU, the GeForce GTX 670 would easily smoke the Radeon HD 7870 GHz Edition chosen by Tom and the GTX 660 selected by Gordon. Those who have high-res panels of 2560x1600 will also benefit from the 670, as it outperform the other video cards at higher resolutions. My processor might not have as much oomph as an FX part or an Ivy Bridge chip, but it gets the job done well enough while my GPU handles the brunt of my PC's load.

Helping to get these video tasks done is 8GB of Kingston Black DDR3/1600 RAM, which will more than suffice for your multitasking needs. The RAM is clocked higher than my competitors' and should give an edge when running multiple programs, too.

Something I found to be interesting is that every part I used in my system came with a manufacturer warranty of two or more years. Gordon, on the other hand, has a case and PSU covered for an almost insulting 30 days. The rig I put together might be lopsided when it comes to my CPU and GPU, but at least it's graphically appealing inside and out. **–CZ**

AM3+: Future Shock

At this budget level, the quality of individual components can be unreliable. Since a person spending this kind of money probably can't afford many replacement parts or major upgrades, it's better to start with the bar set as high as possible. The places you cut corners can end up costing you double when they break down unexpectedly. And you don't want to have to buy a whole new motherboard just to upgrade your CPU or add more RAM. Boards are a pain to replace, and if you have an OEM version of Windows, it's usually a violation of the user license to reinstall the OS on a system that has a different board.

My 970 Extreme3 has heatsinks on the voltage regulators, high-quality capacitors, four RAM slots, several PCI slots, five SATA 6Gb/s ports, three audio outputs, and an eSATA port. And the AM3+ socket should stay relevant for a few more years. None of this shows up directly on a benchmark, but there is high value for a builder who wants reliability, expansion, and adaptation.

The CX500's dual 8-pin PCIe cables can take every single-GPU card available, too. The Evo 212 cooler will allow big overclocks and should be compatible with the next couple of iterations of FX CPUs. The 210 Elite case can take a 24cm radiator despite costing about 50 bucks, and you don't need a modular power supply to keep the insides tidy, thanks to some generous space for cable management. My system may not win every benchmark, but I can say that it's built to last. **–TM**

LGA1155: Looks Ain't Everything

Your honors, let me first state that I intended to present my argument for winning by using a short movie produced and written by Steven Spielberg and directed by J.J. Abrams with Tom Hanks playing my role. That idea was canned when I realized my competitors had no ability to play a DVD, much less burn a CD.

I will instead state my case like so: What matters most? How "pretty" a case is or whether your photo chores take twice as long as the box next to it? Sure, you might get a few more frames at a still unplayable frame rate (is 28fps vs. 23.4fps really something to crow about when you're actually playing the game?), but what about the extra 15 seconds it takes to launch the game or your favorite app? Yes, Windows 8 does indeed have speedier launch times, but it ain't as speedy as you'd expect on a 7,200rpm low-areal-density drive. The LGA1155 truly gives you the luxurious feel of a rig with an SSD.

And lest anyone play the "upgrade" card by saying LGA1155 is a dead man walking, let me remind the judges that there is indeed a healthy upgrade path for this system, as you could drop in a Core i7-3770K tomorrow, if you could afford that luxury chip.

So to reiterate: This is the only balanced system here offering top-of-the-line performance in all categories while giving you smooth, SSD-like responsiveness and an optical drive so you don't have to panhandle a drive or USB stick from your buddy just to install the OS. **–GMU**

Taking It to the Benchmarks

The test scores tell the story of where each rig succeeds and fails

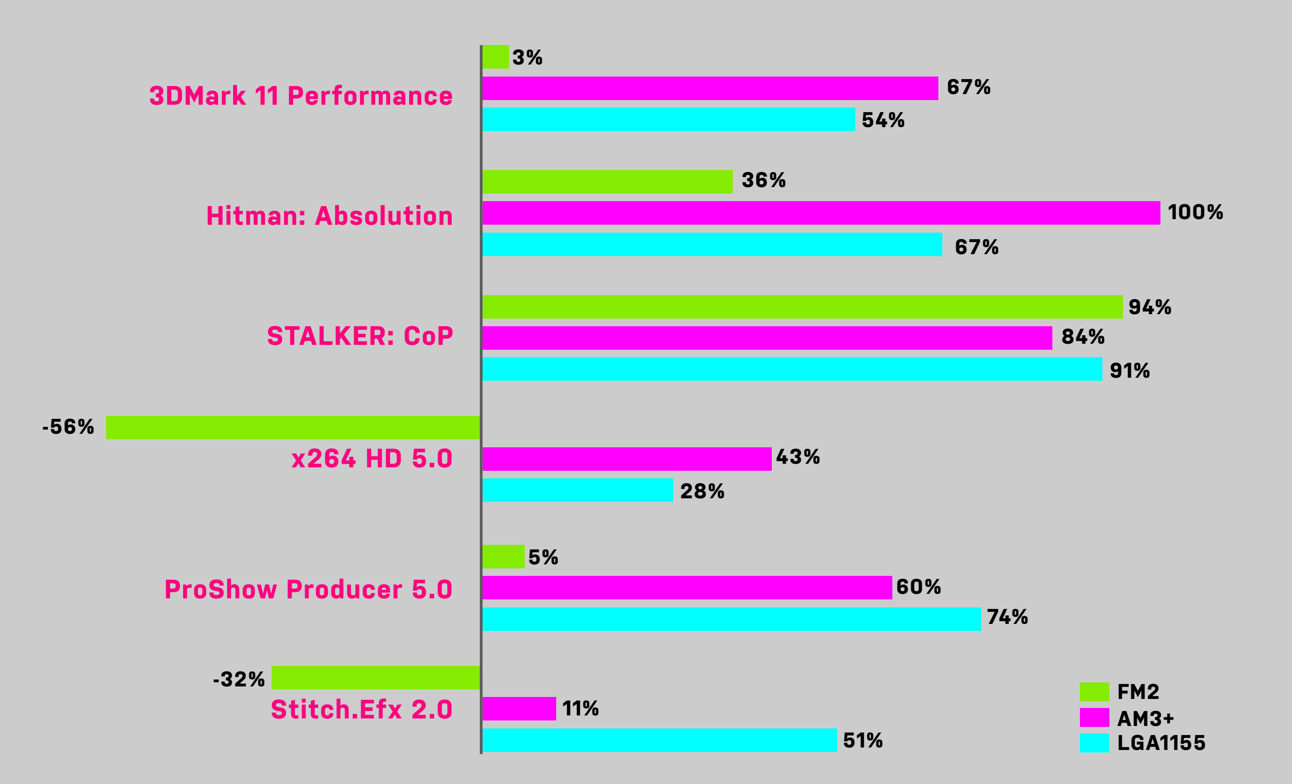
To evaluate the performance of our systems, we pitted them against our current Budget Blueprint, a Phenom II X4 965 box with a fresh install of Windows 8, in a subset of our system benchmarks, in addition to a couple of games run at 1920x1080 rather than the typical nut-busting 2560x1600 we use to test $5,000 boxes. We also ran an additional set of benchmarks to increase our data. You can see the full suite of test results at MaximumPC.com when the story is posted online.

The benchmarks you see here held the most sway over our panel of judges. The results were a bit eye-opening.

First up, our CPU benchmarks. TechArp.com's x264 5.01 encoding test is heavily multithreaded and if you have eight cores, it'll use them. ProShow Producer 5.0 is optimized for four cores and Stitch.EFx 2.0 is a combination: The first two-thirds of the run is single-threaded with the last third exploiting multiple threads. The FM2-based A6 CPU gets destroyed by the FX and Core i5 parts. It even gets pummeled by the Phenom II in x264 and Stich.Efx, but shockingly beats the quad-core Phenom II in ProShow Producer. Between the FX and Core i5, the more efficient i5 easily trounces the FX in Stitch. The spread came as a surprise since we didn't think the relatively low clocks of the Core i5 would spank the FX part so badly, especially with the overclock Tom put on the FX CPU. The overclock definitely helped the FX in ProShow, too. It didn't win, but it came surprisingly close to the Ivy Bridge quad CPU. Finally, in the second pass of x264, the six cores of the FX put it on top—and we expected the Core i5 to take top honors.

Moving on to gaming, we had expected the FM2 platform to spank both other boxes with its $350 GPU, but the dual-core/shared-core design of the CPU put it at a severe disadvantage in 3DMark 11 and Hitman: Absolution. Both feature physics tests, which are CPU-heavy, and the dual-core severely sags. The good news for the FM2 box is that it did manage to win the STALKER: CoP test, but if you look at the numbers, it's not what you'd expect of a $350 GPU. We've long said that gaming is 90 percent GPU, but seeing this data, we're inclined to revise that to 75 percent—but only when coupled with a decent quad-core chip.

Budget Battle Benchmarks



AND THE BEST BUDGET BUILD IS….

To pick our winner, each PC was presented to an independent panel of *Maximum PC* editors not involved in the contest.

The FM2 system was almost immediately eliminated from contention. Yes, it did have the highest score in STALKER: CoP, but that's it, and it wasn't exactly by a large margin. The overall thrashing it took from the LGA1155 and the AM3+ as well as the older Phenom II 965 relegated it to a distant third place in all three judge's eyes.

That made it a two-horse race between the AM3+ and LGA1155 system. After seeing the benchmark data and poking around the interiors of the systems, Judge Josh Norem selected the AM3+ as the winner. Norem said the arguments were pretty clear-cut: The AM3+ has easy upgrade options in the empty DIMM slots, a full ATX motherboard, and a case that's far superior to the LGA1155's Rosewill enclosure for enthusiasts.

Judge Katherine Stevenson, however, sided against Judge Norem, arguing that the better CPU performance and the close-enough gaming performance (Gordon's "28fps vs. 23fps—*big whoop*" argument obviously worked) put the LGA1155 ahead. She also said the SSD caching was a persuasive factor in her pick, as 500GB HDD performance is nothing anyone wants to be stuck with, even if the case is prettier. Judge Stevenson even did some mouse driving on both systems and timed how long it took to launch games and apps and boot the systems. The results only cemented her belief that the LGA1155, though ugly as hell, was the winner.

The swing vote on the panel was Judge Jimmy Thang. Judge Thang crunched the benchmark numbers and decided that the LGA1155 was the overall better system. Judge Thang felt the CPU-heavy wins were more persuasive than the GPU wins, which were pretty close when you look at the frame rates. He also said the caching SSD proved to be a critical advantage in performance and agreed that the ability to cut application and launch times outweighed a sturdier PSU or case since those don't impact felt performance.

It's not a unanimous decision, but the judges have ruled: The LGA1155 system is the Budget Build winner.

IS YOUR NEXT PC A TABLET?

We test Microsoft's Surface Pro workhorse tablet in several common desktop-use cases to see how it stacks up to a traditional PC

For the last three years, there have been questions about what the spectacular rise of the iPad and other tablet computers means for the traditional desktop PC. Are tablet sales cannibalizing PC sales (the "post-PC" worldview), or is this simply a new category that people are buying alongside traditional computers? Will the tablet remain a third device, between a smartphone and a PC, or will it gradually take over the role that's currently played by laptop and desktop computers? With the release of the Surface Pro, Microsoft isn't making these questions any easier to answer.

The Surface Pro looks like a tablet, but using one feels suspiciously like using a laptop computer. Up until now, tablets have been characterized by their inability to run powerful desktop software like Photoshop and Microsoft Office, but that distinction is gone on the Surface Pro—a tablet that can run any Windows software. A tablet but also a general-purpose computer, the Surface Pro is blurring all the lines.

Are devices like the Surface Pro eventually going to render the PC obsolete? We decided to find out, by using one to do every kind of computing task we could think of—from surfing the web to designing a website. We broke our findings down by the different kinds of PC users that are out there, so find the page that describes you, and discover if your next PC could be a tablet.

BY ALEX CASTLE




Start
Justin
Harrison
Wendy Teo
RE: Dinner tonight? Sounds good. How about the new place with the back patio?
Mail
8
Soccer practice
Rec Center
5:30 PM – 8:00 PM
8
Monday
Internet Explorer
Store
Bing
Photos
Maps
SkyDrive
Sports
Messaging
71°
Seattle
Mostly sunny 53° / 72°
Weather
Hot air balloon festival takes off in the valley this weekend
Music
Video

CASUAL USER

Just the basics

PASS

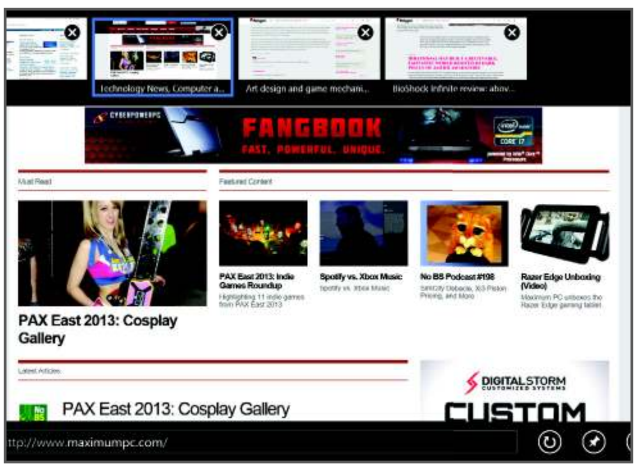
First off, we're going to look at what we consider the baseline for a casual PC user. These are the functions that any tablet, laptop, or desktop computer needs to be able to perform, and flawlessly. Because of this, we're going to be a little stricter with these programs in the screen and input categories—if we have to plug in a mouse to check our email, something's gone woefully wrong.

WEB BROWSING

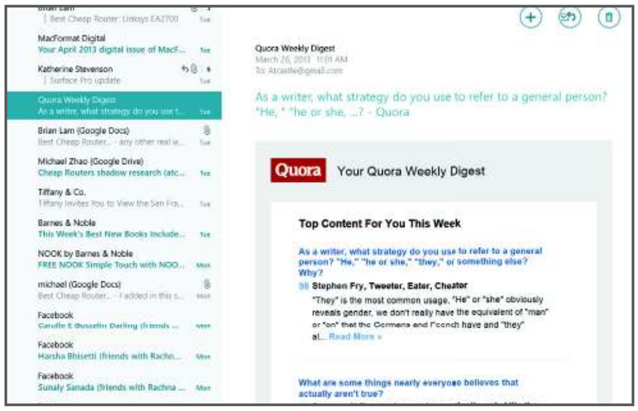
Fortunately, the Surface Pro starts out our casual test on the right note—browsing the web on the Surface is a great experience. Internet Explorer 10 on the Modern UI comes with a sharp custom interface that makes it easy to surf, search, and switch tabs using only the Surface's touchscreen. When the Type Cover isn't plugged in, the virtual keyboard pops up whenever you need it, and when you're not using the address bar or tab switcher, they slide out of the way, letting the site take up all of the Surface's screen space.

Surfing in desktop mode is less thrilling. Even with the default 150 percent magnification, interface elements are a little difficult to hit reliably using the touchscreen, and to get the virtual keyboard on screen you have to hit a small icon in the system tray, then you have to manually close it (again, with a too-small button) to get it out of your way when you're done. All this makes trying to use the desktop version of IE with touch a huge pain—we recommend sticking with the Modern version.

There's just one problem with that, though. While the latest version of Internet Explorer is actually very fast and quite nice to use, we still prefer Chrome a bit more. Unfortunately, if you set any browser other than Internet Explorer to be your default browser in the desktop mode, you cannot use the tablet-optimized version of IE, crippling the Surface's ability to surf the web on the go. Pretty scummy.



The tablet version of IE10 is much more touch-friendly than the desktop version.



Microsoft's email app looks nice, but has a small fraction of the power of Outlook.

EMAIL & MESSAGING

The state of messaging on the Surface Pro is a little more disappointing. The built-in email app looks nice, but feels a little half-baked. Threaded message navigation is a bit difficult, and there's no way to search through messages that haven't been loaded onto your device. It does the job fine, but you'll probably find that you like using a Gmail or Hotmail account in the tablet-optimized browser better. If you're using a non-webmail account, and want greater-than-webmail functionality, your only choice is good-ol' Outlook, which works just fine, and is even reasonably touch-friendly on the Surface.

If you're still on the IM bandwagon, you'll be pleased to know that the Surface Pro has a great messaging client in the form of IM+, available in free and paid ($5) versions on the Microsoft Store. The desktop Digsby and Pidgin apps work, as well, though once again you might find yourself struggling to use their interfaces with the touchscreen.

MEDIA

As a platform for consuming media, the Surface Pro is as good as it gets. The built-in Xbox media apps are pretty bogus, but you are of course free to download iTunes or VLC or any other media players or managers that run on Windows. Video content looks absolutely gorgeous on the 1080p screen, and unlike with the iPad's crazy "Retina" display, you can actually find plenty of content that takes full advantage of it.

WHAT'S THE VERDICT?

The Surface Pro's got more than enough power for any casual computing need, and as long as you stick to tablet-optimized apps, the experience is excellent. Still, if this is all you're doing, a cheaper, lighter tablet might be better suited for you.

OFFICE USER

You never have to leave the office behind

PASS

Now, we'll start to get into what sets the Surface Pro apart from other tablets. Though others offer some minor-league productivity software, none of them give you access to the full ecosystem of Windows office applications. This is where we expect the Surface to shine.

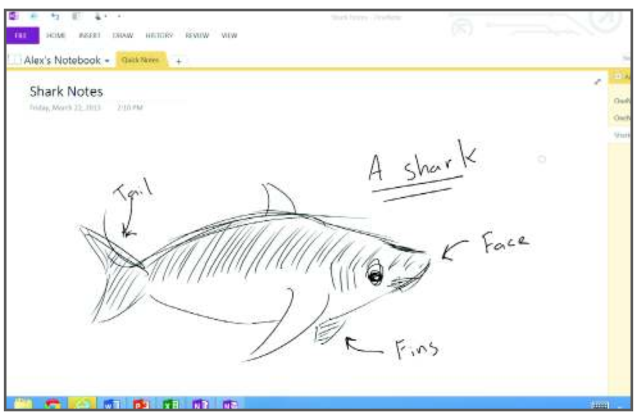
MICROSOFT OFFICE

We'll start, of course, with the cornerstone of the Windows productivity world—Microsoft Office. Although it's not fully integrated with the tablet interface, Microsoft has clearly spent some effort getting the programs ready for tablet use, with a number of touch-centric features.

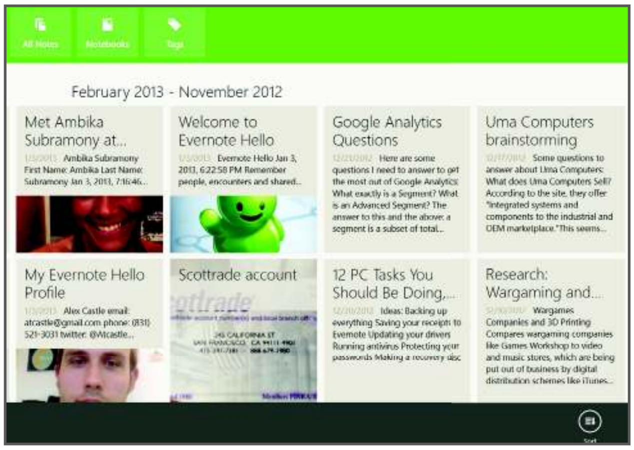
The redesigned ribbon, with its flat aesthetic, is well-suited for touch use. The menu buttons are spaced far enough apart, and the programs can tell when you press one with your finger rather than a mouse. When you do, a separate version of the ribbon is displayed, which is slightly larger and spaces the buttons farther apart for easier touch. The applications also allow you to swipe to pan around your documents, and feature pinch-to-zoom. All the gesture recognition is highly responsive and smooth.

Additionally, all the software works with the stylus. Simply bring the stylus anywhere near the screen and a previously hidden Pen menu appears, which allows you draw or highlight anywhere on your document. This feature works essentially identically across Word, Excel, and PowerPoint—your scribblings occupy a layer of their own, unrelated to whatever document is beneath them, but it's pretty handy for making quick notes on a shared document.

OneNote has always been a black sheep in the Office family, but the note-taking application really comes into its own on the Surface Pro. The stylus is great for drawing quick diagrams or taking handwritten notes, and the program's infinitely scrolling notepad conceit is greatly enhanced by the ability to pan and zoom with your fingers. Though Evernote has long been our note-taking application of choice,



Neither the tablet version of Evernote (pictured) nor the desktop version is a perfect fit for the Surface Pro.



OneNote's never been as useful as it is on the Surface.

OneNote really seems like the better pick on the Surface Pro.

The Office UIs look perfectly crisp under the standard 150 percent magnification, and respond well when the screen changes orientations. A lot of programs end up improperly maximized when you switch from landscape to portrait mode and back, but Office works great—handy when you want to type a document using the Type Cover, then detach it and do some quick editing with the stylus.

Performance-wise, Office gets a pass. We opened large documents in Word, Excel, and PowerPoint at the same time, without putting a dent in the Surface Pro's performance.

OTHER APPLICATIONS

File-syncing apps are no problem, of course—the Surface Pro comes with some free SkyDrive space, but we didn't have any issues using Dropbox, SugarSync, and Google Drive. The Pro's limited hard drive space (just under 90GB is usable on the 128GB model) means packrats will have to think twice about syncing their whole Dropbox.

There are two ways to use Evernote on the Surface Pro. There's a tablet version of the program in the Microsoft Store, which is pretty watered-down, features-wise but has a nice interface, and there's the normal desktop client. The desktop client's interface is a little hard to use without a mouse or the stylus, but the "Ink Notes" feature works very well for pressure-sensitive sketching.

WHAT'S THE VERDICT?

If you're looking for a tablet that can give you access to high-quality productivity tools, the Surface Pro is probably the best choice for you. Other tablets like the iPad offer some decent document-creating power, but they can't compete with the feature set of the real-deal Office suite.

DEVELOPER

Coders have a lot to love in the Surface Pro

PASS

One of Microsoft's most loyal contingencies has always been developers. That hasn't stopped them from writing programs for other platforms (see the underpopulated Windows Store for evidence of that), but Windows has always been the platform with the best tools for software creation. We decided to try out Visual Studio on the Surface Pro, along with the popular game design engine Unity 3D.

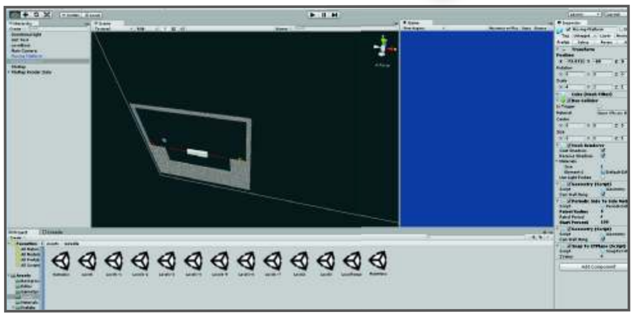
VISUAL STUDIO

Microsoft's Visual Studio is an incredibly sophisticated development environment, with a robust feature set. If any IDE is going to give the Surface performance trouble, it would be Visual Studio. In our testing, the Surface Pro is more than up to the challenge. Admittedly, that wasn't a huge surprise for us—plenty of people code on laptops with worse specs than the Surface Pro. The real question is whether the form factor works well for development.

Only a masochist would try and write code with an onscreen keyboard, so the Type Cover is a must for would-be Surface developers. Even then, the Surface Pro isn't quite ideal; the touch keyboard's trackpad occasionally picks up your thumbs when you don't want it to, and deposits the cursor at some arbitrary point in your code. With a Bluetooth keyboard, we had no problems with the Surface Pro, and had a great time coding with it at a nearby Starbucks.

UNITY 3D

The Unity game engine has contributed to the recent boom in indie game development, with a capable, efficient development environment and a college-student-friendly pricing structure. Does it play nice with the Surface Pro?



Game development on a tablet is more than possible with Unity 3D and the Surface Pro.

Sure it does! We had no difficulty opening and editing large game projects, installing editor add-ons, or test-running games on the Surface Pro. The only drawback we found is that Unity is not yet able to handle the Windows 8 touch events, meaning you cannot code and test a game on the same machine—yet. The Unity team has promised support for Windows 8 touch in an upcoming version of the engine.

WHAT'S THE VERDICT?

The Surface Pro is an excellent machine for developers, but think about picking up a Bluetooth or USB keyboard.

ARTIST

Putting the stylus to the test

MIXED

Stylus input is hardly a new concept in computing, but since the iPhone, it's been out of favor in mobile devices. And although multitouch is great for basic navigation, for art, you might as well be finger painting. We decided to find out if the Surface lives up to its potential.

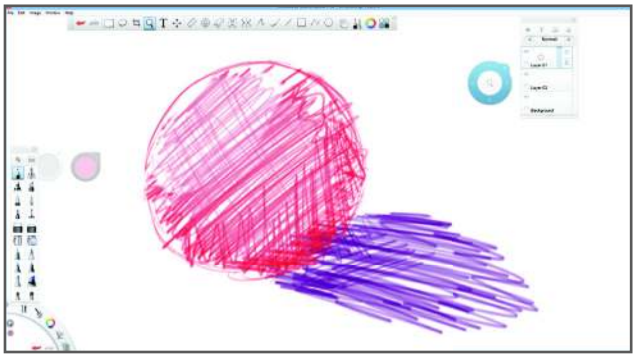
PHOTO EDITING

Photoshop is the flagship of Adobe's sprawling Creative Suite, and probably the most widely used professional creative software in the world. It's also not exactly lightweight, as far as far as system requirements, so we were excited to see how well it runs on the Surface Pro.

Quite well, as it turns out. Like most Adobe software, Photoshop doesn't rely heavily on the GPU, and the Surface Pro's Core i5 CPU provides enough horsepower to handle whatever Photoshop threw at it. Even when opening huge raw files and applying all the most intensive filters in CS6, we couldn't get the Surface Pro to so much as stutter. The system's 4GB of memory isn't puny, exactly,



Photoshop's miniscule buttons are hard to hit, even with the stylus.



Sketchbook Pro's interface features radial menus and can be quickly navigated with stylus swipes.

but it would be very possible to use it up opening a bunch of large files at once.

So for photographers, the Surface Pro could be an invaluable piece of gear. No matter where you are, you can plug your camera into the Surface Pro's USB port, transfer over some photos, tweak and edit them, and upload or save them until you get home. Plugged into an external monitor (at the tablet's native 1920x1080 resolution), you could even use the Surface Pro as a capable desktop workstation.

DIGITAL GRAPHICS

For digital painters and other graphic artists, it's a little more of a mixed bag. Photoshop performance is still fairly good, but brush lag started to show up with brush sizes larger than 25 pixels or so. Unfortunately, at the time of writing, most high-end digital painting software, including Photoshop and Corel Painter, doesn't support the Surface Pro's pressure-sensitive stylus driver. You can still use the stylus as a mouse-surrogate, but the eraser doesn't work, and pressure sensitivity—an important feature for natural-looking drawing—doesn't register. Additionally, we encountered some persistent issues with line smoothness across multiple art programs. The problem wasn't present when we plugged a Wacom Intuos 5 into the Surface, leading us to believe that it, too, is related to the driver problems. For its part, a Surface representative told us, "Microsoft is working with the necessary partners to make advanced features of the Surface pen available across a number of applications in the near future."

One of the main problems with running Photoshop on the Surface Pro (and this holds true for almost every program in this section) is that you lose access to time-saving keyboard shortcuts. Combined with too-small interfaces, your workflow can really be slowed down. Fortunately, enterprising users have ported a popular Autohotkey script called Artdock to the Surface Pro (available at http://bit.ly/YCrgo0), which adds a context-sensitive tray of touch-size icons that make it easy to access common hotkeys in any popular art software.

SKETCHBOOK PRO

Though the software doesn't have the expansive feature set of more expensive art programs like Corel Painter, Autodesk's Sketchbook Pro takes much better advantage of the Surface Pro's hardware. It works perfectly with the Surface's pressure-sensitive stylus, and all interface elements are designed to be accessible through nested radial menus, so you can quickly control the program without ever setting down the stylus. Our only beef with the program is that, unlike the simpler, app store Sketchbook, the Pro version doesn't respond to multitouch gestures, making it unnecessarily difficult to pan and zoom.

WHAT'S THE VERDICT?

For photographers, the Surface has a lot to offer. It's the only way you'll get good portable Photoshop performance in such a small form factor, and the stylus lets you do some basic photo editing without so much as a desk or a chair. For digital artists, a Surface loaded with Sketchbook Pro is a fun way to do some digital sketching wherever you are. However, for professional-quality work, you won't want to sell your Wacom just yet—at least not until Microsoft sorts out the stylus driver issues currently hindering the Surface Pro.

WHAT MAKES SOFTWARE TABLET-FRIENDLY?

While testing a whole heap of software on the Surface Pro, we've discovered a few common threads among programs that piss us off. Here are the three main things we look for when evaluating whether a program is Surface-friendly or not:

Performance Of course, we're going to answer the most obvious question—will it run? Now, remember that the Surface Pro's hardware is equivalent to that of a decent Ultrabook, not your average tablet. We expect programs to run and run well.

Resolution and Screen Size One thing that sets the Surface apart from your standard laptop is its screen. The Surface Pro has a high-resolution (1920x1080), 10-inch display with a narrow 19:9 aspect ratio. With so many pixels across a small expanse, normal Windows applications tend to look teeny-tiny, and text can be incredibly difficult to read. To compensate, Microsoft has set the Surface Pro desktop mode to default to a magnification of 150 percent. This solves the readability problem, but screws up some applications. Worse still, in order to change between 150 percent and normal magnification, you have to go into a settings menu and make a change that logs you out of Windows, closing all your programs. If the program isn't functional and readable on the Surface's small screen, or requires that we turn off screen magnification, that's a fail.

Input The final major consideration is how software handles the Surface Pro's unique set of input hardware. If software works well with the touchscreen, that's a big plus. If the pressure-sensitive stylus is useful, that's also a plus. If you can at least use the program efficiently with only the Type Cover—well, we'll take that. But if the software requires a separate mouse and keyboard, that's a fail.

DESIGN

Put away those MacBooks

PASS

You might tend to associate the trendy graphic and web design crowd with Mac computers, but they have a lot to gain with the Surface Pro. Like art applications, design software works best with a stylus, but absolute, pixel-perfect fidelity isn't quite as crucial, and elements can be easily adjusted after they're first placed. Here are our impressions after trying a large variety of design software on the Surface Pro.

ILLUSTRATOR AND FLASH

Using Adobe's vector-drawing application Illustrator on the Surface Pro is, in a lot of ways, similar to using Photoshop. The two programs have similarly laid-out interfaces, with tightly packed trays of small buttons. With the stylus it's not too hard to select the tools you need, but the stylus's accuracy drops off as you near the edges and corners of the screen, making it quite hard to hit the menu bar at the top of the program.

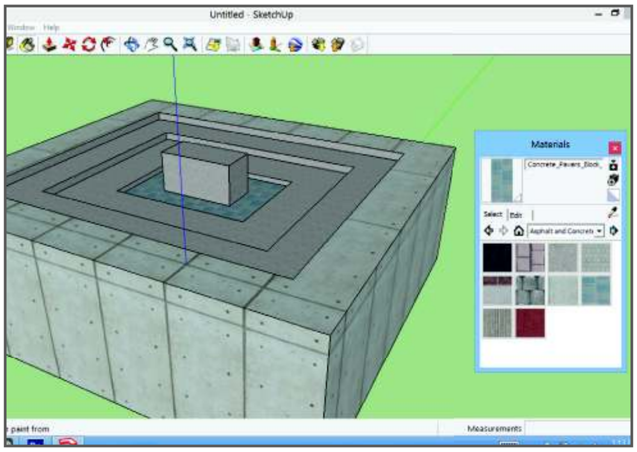
Flash's interface is even more packed, with the important timeline requiring some extra-precise stylus work to use. We'd recommend a separate mouse for anyone doing animation work on the Surface Pro.

Like all the Adobe products, neither Illustrator nor Flash currently offers pressure sensitivity with the Surface Pro's stylus. Fortunately, for creative work, pen pressure is a lot less critical in vector-based programs than in Photoshop, as most linework is done with the control-point-driven Pen tool, rather than freehand.

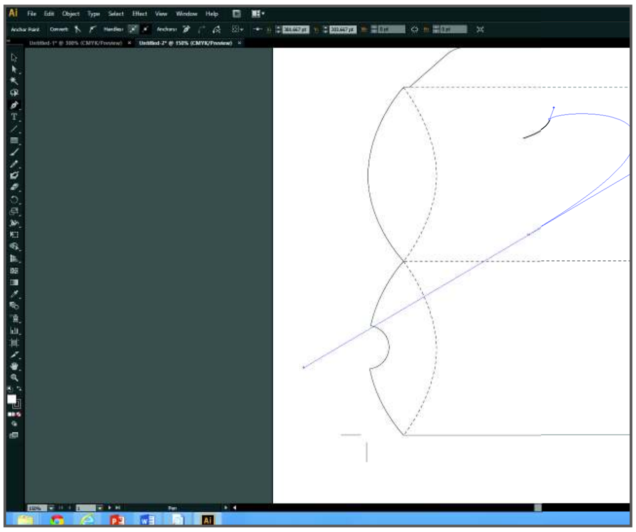
We opened several very large Illustrator and Flash files, and neither ever showed any signs of slowing.

SKETCHUP

3D modeling is the sort of high-precision, involved work that isn't likely to migrate off the workstation and onto a tablet anytime soon. But Sketchup (formally owned by Google, now Trimble) offers a more design-centric take on 3D, letting you build up low-poly 3D models with minimal mousework—an excellent candidate for the Surface Pro.



Sketchup is a blast to use on the tablet, even if the stylus slows you down.



Adobe illustrator's pen tool makes it easy to draw without pressure sensitivity.

The program runs perfectly smoothly, and building 3D objects by extruding and morphing basic shapes using the touchscreen is very satisfying. For any sort of precision, you'll need the stylus, which is a natural fit for drawing lines and shapes on the screen, then extruding those into 3D. The major drawback is that the stylus lacks scroll-wheel and center-click functionality, which makes zooming and rotating the scene a chore.

DREAMWEAVER

Dreamweaver suffers from some of the same interface issues as the other Adobe software, but on the whole there's very little drawback to using it on the tablet. The stylus is enough precision for most tasks in Dreamweaver, and the Type Cover is convenient when you need to quickly drop into HTML view. The only thing we'd like to see in a future version of the Surface Pro is 3G, for mobile publishing.

WHAT'S THE VERDICT?

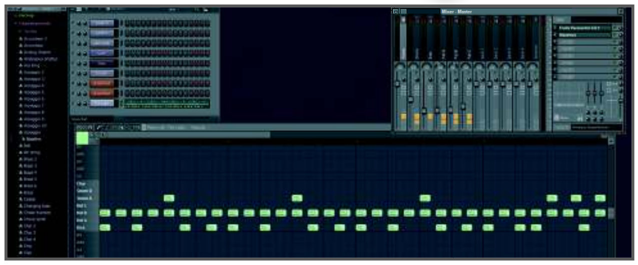
The Surface Pro is an excellent platform for designers who can pry themselves away from the Mac ecosystem. Full-featured design programs like Illustrator work like a charm on the Surface Pro, and the stylus issues that gave us grief in art programs are much less of an issue here. If you're looking for a way to do high-quality design work during boring meetings or while sitting on the couch, you won't do better than the Surface Pro.

MUSICIAN

Don't sell your workstations yet

FAIL

If you're a digital musician looking for a capable, portable tool for music creation, you've probably given a lot of thought to the iPad, which offers a number of excellent—if limited—digital instruments and music apps. As a competitor, the Surface Pro is a mixed bag. To start with, the app support just isn't there yet. The Microsoft Store is a little barren, and its minimal design and low number of user reviews makes it difficult to find the best picks. On the positive side, many apps in the store offer a trial option before you buy, which can be a big help in choosing the music tools that are right for your purposes. Additionally, we found the Surface's widescreen aspect ratio better suited than the iPad's for simulating keyboards and a variety of virtual instruments.



Digital audio workstation FL Studio is just a little too dense for the small Surface Pro screen.

DIGITAL AUDIO WORKSTATIONS

The Surface's real advantage comes from its ability to use the full desktop version of your favorite Digital Audio Workstation (DAW) on the go. We tried out Cakewalk Sonar X-2 and FL Studio on the Surface Pro, to see how it fared for mobile music production.

On one hand, it's sort of unbelievable to have the sort of powerful production tools like Sonar in your lap on a small(ish) tablet. On the other hand, the Surface's hardware just isn't quite right for the software—DAWs are notorious for having cluttered, tightly packed interfaces, and we found it very hard to use them without a mouse. Even with the stylus, which normally serves as a decent mouse-replacement, navigating both programs' interfaces was hard on the wrist and eyes.

Of course, you could plug a mouse and external monitor into the Surface, but at that point you'd be better off with a workstation, or at least a laptop. The Surface Pro's 4GB of RAM will start to hold you back in these programs, too, especially if you're working on a project with multiple sampled instruments.

WHAT'S THE VERDICT?

Using big-boy music production software on a tablet is novel, but it's just not a great fit.

VIDEO EDITING

Up to the task, if you are

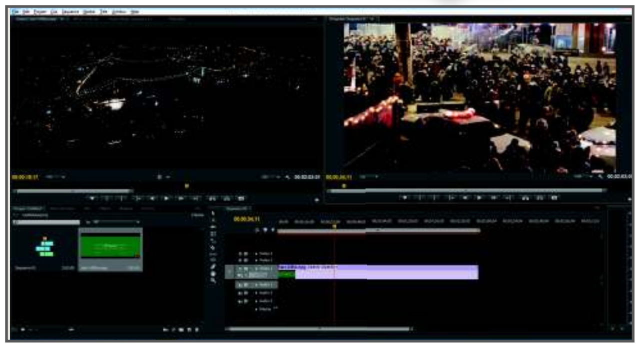
MIXED

Going into our testing, the area where we most expected the Surface Pro to run into performance problems was in video editing. Rendering and encoding HD video are two of the most hardware-intensive computing tasks normal users do, and the Surface Pro's hardware is good, but hardly cutting-edge.

We were surprised to find that the Surface holds its own quite well in Premiere Pro. HD video rendering wasn't lightning-fast, but it was well within what we'd consider the acceptable range for home use. In our x264 encoding tests, the Surface Pro clocked in at around 6 frames per second—a decent score that we'd expect from a low-powered desktop PC.

The only real issue we had with video rendering or encoding was that the Surface Pro—which has a tendency to run hot and loud—runs at its absolute hottest and loudest while performing these demanding tasks. It's not a deal breaker, but the Surface gets hot enough that it's uncomfortable to hold for extended periods of time, or hold directly on your lap. In addition, we saw battery life drop precipitously while working with video.

The Premiere Pro interface is hardly touch-friendly, of course, and the software's interface is a little too dense. On the plus side, HD video looks so good on the Surface Pro's top-notch screen that you might not miss your larger monitor.



Premier Pro running on a tablet? We never thought we'd see the day.

WHAT'S THE VERDICT?

The Surface is a surprisingly capable video editor, and is a valid choice for putting together vacation video in a hotel room, or other low-level jobs. For professional or hardcore hobbyists, the Surface Pro's limited hardware will send you scrambling for your workstation.

THE FINAL FRONTIER: GAMING

Does Microsoft have a mobile gaming platform in the Surface Pro?

One of the best-kept secrets about the Surface Pro is that it's actually a surprisingly capable gaming platform. No, you're not going to be able to play the latest Crysis or Far Cry, but you're also not stuck playing the same kind of watered-down games you get on other tablets. As long as you know which games work best on the Surface Pro, you can play the kind of deep, engaging, and original games that you just can't play on any other handheld device. Here are a few of our favorites.

CIVILIZATION V

As the only triple-A PC game that currently offers touchscreen-optimized play, Civ 5 is the perfect game to show off the Surface Pro's gaming prowess. Performance isn't flawless (with default settings, frame rate sometimes drops into the low double digits), but the turn-based nature of the game makes it a lot more forgiving of lag. The gesture-based controls make it easy to control even a sprawling empire with the touchscreen, and you'll never find yourself reaching for the Type Cover.



XCOM: ENEMY UNKNOWN

XCOM is a great Surface Pro game for basically the same reasons as Civilization V is—it's a high-quality, deep title that doesn't demand split-second reaction times of players. It doesn't feature touch-optimized gesture controls, but the touchscreen works well enough for any game that can be played entirely with the mouse. If you find yourself wanting a little more precision, try playing with the stylus.



TOME

Tales of Maj'Eyal (TOME, to most) is a roguelike—the genre of punishingly difficult dungeon crawlers that practically defines the sort of game you can only find on the PC. The low system requirements of roguelikes makes them great for playing on the Surface Pro, but the best are graphical games that can be controlled with the mouse, like TOME. Many of the ASCII games are very keyboard-centric (e.g., Dwarf Fortress), making them a poor choice for play if you don't have the Type Cover or a USB or Bluetooth keyboard.

EVERYTHING ELSE

Finally, we'll point out that there are a ton of amazing games, like Diablo III, Portal 2, World of Warcraft, and Minecraft, that the Surface Pro is capable of playing. We hesitate to call these tablet-friendly games, though, because they still require mouse-and-keyboard input. The Type Cover's WASD keys work well enough, but the arrow keys are oddly arranged, and God help anyone who tries to use the Type Cover's trackpad for mouselook. So, though it's great that you can play a wide variety of games on the Surface, the need for a mouse and keyboard will put some limits on your mobility.

WHAT ABOUT STEAM?

One of the weakest links in the Surface Pro gaming ecosystem is Steam, which is resolutely un-touch-friendly. Many games don't work when the Surface Pro's magnification is turned on, but without it Steam's tiny scroll bars and menus are incredibly difficult to hit. Big Picture mode seems like it would be better for tablet use, with enlarged interface elements, but the controller-centric design is even harder to navigate with the touchscreen alone. You're better off pinning each game you regularly play to the Windows 8 Start screen.



WHAT'S THE VERDICT?

The Surface Pro isn't likely to take over as your primary gaming machine, but it's more of a contender than you might think. For fans of strategy games and independent releases, the Surface Pro could be the perfect portable gaming platform. For action-oriented gamers, you're better off with an Ultrabook or dedicated gaming laptop.

MIXED

EVERYTHING YOU WANTED TO KNOW ABOUT SSDs BUT WERE AFRAID TO ASK

YOU'VE GOT QUESTIONS, WE'VE GOT ANSWERS. IT'S TIME FOR A CRASH COURSE IN SOLID-STATE DRIVE TECHNOLOGY

BY JOSH NOREM

Solid-state drives are taking the PC world by storm with their silent operation, blazing speeds, and ever-sinking prices, and yet you're hesitant to buy one. Maybe you're afraid of SSDs, or you don't think you know enough to make an educated purchase, or maybe a bad SSD controller took all your data down to Chinatown. Regardless of the reason for your trepidation, every horsepower junkie should be getting in on the SSD action, and to do that you need a little bit of cash and a whole lot of knowledge. Over the next several pages we will attempt to answer all of your SSD-related questions. We'll walk you through all the reasons why you need an SSD first, then break down the terminology so you can talk like an SSD badass at the next LAN party, then show you the parts of an SSD so you know how it all fits together, and we'll wrap it up with a discussion of the software you'll need to monitor and optimize your drive. Though SSDs might seem complicated with their 24nm synchronous MLC Toggle NAND flash and their AHCI-enabled SATA 6Gb/s IOPS gobbledygook, you're about to find out they are not as scary as you thought they were.



VECTOR
2.5" solid state drive
INDILINX
INFUSED
ocztechnology
CORSAIR
SATA 3
SOLID-STATE DRIVE
240GB
NEUTRON
WARRANTY VOID IF REMOVED
MADE IN TAIWAN
SAMSUNG
M4
SOLID STATE DRIVE
crucial
intel

WHAT IS AN SSD AND WHY SHOULD YOU CARE?

Demonic speed and immunity to tumbles are part of the story

Let's start with the basics. An SSD is a solid-state drive, meaning it has no moving parts. It's basically a thin slice of NAND flash memory that's similar to what you find in a USB thumb drive, though instead of being jammed into a finger-size stick it's stuffed inside a 2.5-inch enclosure with a SATA interface. As you have probably heard, SSDs are several orders of magnitude faster than mechanical hard drives for one simple reason: Instead of waiting for the hard drive platters to spin under the read/write heads, you are pulling data from NAND flash memory, so access times are nearly instant. SSDs are so fast that some of them are currently able to completely saturate today's SATA spec, pumping roughly 550MB/s of data through the SATA 6Gb/s interface, whereas the fastest 7,200rpm hard drive would be lucky to hit 150MB/s across the platter. Other benefits of SSDs are that they generate no noise since there are no moving parts, which also lets them produce much less heat. They can still get a little warm, but don't require active cooling like a hard drive does. And since they have no moving parts, you're free to wedge one into your laptop and toss it around like the bouquet at a wedding, though we don't recommend doing that. To summarize, SSDs offer tremendous speed, emit no noise, give off very little heat, and fit in the space the size of a few credit cards. What's not to love?

WHAT'S NOT TO LOVE

Here's the downside: SSDs are expensive, and there's also the chance that whatever drive you select might die on you one day. Now, we know that doesn't sound good, but there are some silver linings here. The first is that prices are dropping rapidly, so much so that right now 128GB drives are hovering around $100, so that's less than the magical $1-per-gigabyte price bar we've set for an OK deal. Drives with capacities of 256GB are even less expensive, averaging around $160. Sadly, 512GB drives are still a smidge spendy, and 1TB drives, well, they don't even really exist for mere mortals. SSD prices will continue to fall, though, as adoption rates increase, so any financial barrier to entry you might fear will soon be nonexistent.

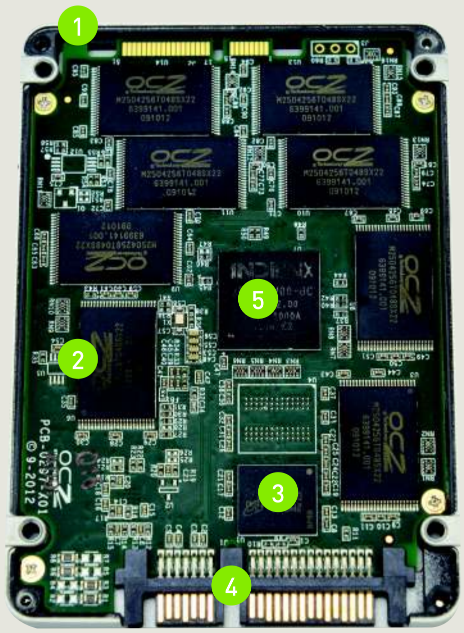
The second point is much more concerning to you, as nobody enjoys seeing their data go bye-bye. Let's just get this out of the way: Many people have had their SSDs fail. We've had our own personal SSDs fail in our home machines, and seen units here die an untimely death in the Lab, in seemingly random fashion. What needs to be made clear, though, is the fact that in all of these cases it was the controller that gave out, not the NAND flash itself. Anyone who tells you they have reached the end of the life cycle for NAND flash is either high, lying, or from the Internet, so don't believe them. It's not the flash that typically dies, but the controllers, and here's the good news: Things are improving massively on this front. In fact, we've yet to see a late-model SSD die, and chalk up the earlier failures to the fact that it was simply new technology, not yet battle-tested on the front lines. You might recall several high-profile SSD recalls, as well, which didn't help their status as a fledgling technology. The simple truth is that those days are mostly behind us, and as controller and firmware technology has matured, reliability has improved greatly, so we have zero problems recommending any late-model SSD but, as always, you should back up your data regardless of the storage medium you have in place.

THE EVOLUTION OF SSD FORM FACTORS

When SSDs first burst onto the scene, they came in unwieldy 3.5-inch enclosures the size of hard drives. These SSDs were blazing-fast at the time, and ungodly expensive. We're talking $1,000 for 64GB, but back then it was all that we had, so we paid it. SSDs eventually migrated to the 2.5-inch enclosures that we use now, and are also offered in the teeny, tiny mSATA form factor for notebooks, as well. If this downsizing trend continues, we expect future SSDs to be microscipic (far right.)



ANATOMY OF AN SSD



1. OUTER SHELL
This shell could be plastic or metal, and helps absorb some of the heat from the flash memory inside. A 7mm shell allows an SSD to be used in an Ultrabook, though some employ the thicker 9mm form factor. Unlike with a mechanical hard drive, you could remove this cover and run an SSD commando and it would not make much difference to the drive, though we don't recommend it.

2. NAND FLASH
These are the memory chips that hold your data. They are typically clustered in groups of chips covering both sides of the PCB. Most SSDs you will see use either MLC or TLC NAND, though if this was an enterprise-level model it might use SLC NAND flash. MLC flash wears down twice as fast as SLC flash, and TLC wears down quicker than MLC, but you will still get many years of usage from MLC or TLC.

3. DRAM BUFFER
Every SSD also includes a bit of DRAM used for buffering purposes. Like cache on a hard drive, data is stored here temporarily before it's written to the device. Wear-leveling data is also placed into the cache while the drive is running. SandForce SSDs are the only models that do not use external DRAM.

4. POWER AND DATA INTERFACE
Modern SSDs ship with SATA 6Gb/s interfaces that allow for roughly 550MB/s read and write speeds, though this will change soon since today's drives are saturating the bus. The next-gen interface, called SATA Express, will utilize PCI Express lanes instead, allowing us to eventually hit up to 16Gb/s of throughput. Yes, we are salivating.

5. CONTROLLER
The controller runs the show, usually with a multicore processor. This is what separates one SSD from another, for the most part, though custom firmware designed by the drive manufacturer is also a factor. Controllers communicate with NAND over parallel channels, compress and uncompress data, and keep the drive optimized with garbage collection.

SOLID-STATE TERMINOLOGY

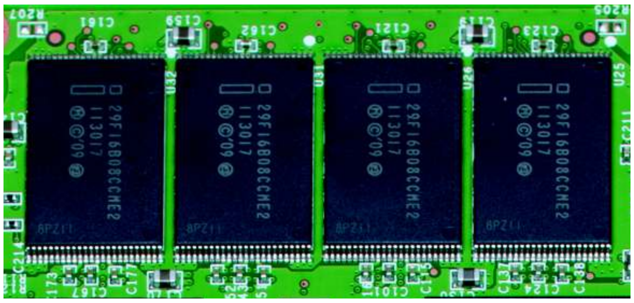
Or how to look like you know what you're talking about

NAND FLASH
NAND flash is a type of nonvolatile flash memory that stands for "Not And," which is a reference to the type of logic gate it uses. This is different from NOR flash, which is used in environments where the same program is run over and over again. NAND memory is popular due to its speed, durability, and relatively low cost compared to DRAM, and is commonly found in storage devices such as USB keys, tablets, cell phones, and of course, SSDs. Though there are various types of NAND flash, all SSDs on the market currently use this type of memory.

CONTROLLER
This is the brains of the SSD and what truly separates one drive from another, as they mostly use very similar NAND flash. Typical controllers today use multiple cores for running the drive, performing data compression, and executing drive optimizations. Before you make any purchasing decisions about an SSD, find out which controller it uses, as some controllers have a checkered history. Currently only Samsung and OCZ have controllers that were designed and manufactured in-house, which theoretically gives them an advantage, while Intel uses SandForce, Corsair uses Link A Media, and Crucial uses a Marvell controller.

MLC NAND

This is the most common type of NAND flash used in SSDs today, and it stands for "multi-level cell" memory. Its much more expensive counterpart is SLC, or "single-level cell" memory. In SLC, only one state can be maintained per cell, making it good for one bit of data. In MLC, however, up to four states can be stored per cell, allowing it to hold two bits of data. The proximity of the two states creates the possibility for more errors, though, which is why SLC is so expensive, and rare. Flash memory can only sustain a finite number of read/write operations but modern day SSDs perform wear-leveling in order to allow them to survive for a decade or longer depending on drive activity levels.



SLC NAND

This is the good stuff. SLC NAND is very expensive and is only found in enterprise-level storage products due to its cost. It stores one data state per cell, and since there are no other data states nearby, it is extremely accurate and long-lasting. At press time a 256GB SLC SSD costs $2,600, so you won't be seeing them in your home machine any time soon.

TRIM

Trim is something you'll hear about a lot with SSDs, because it performs the crucial function of helping the SSD optimize itself when it is idle, so *not* having Trim support is bad, and it needs to be in both the drive and your OS. Essentially, the Trim command is sent from the OS to the drive's controller to tell it which bits of data can be safely deleted, so without Trim the drive could theoretically just fill up and degrade. Since NAND cells cannot be overwritten, they must be erased before new data is written to them. The command also lets the controller reorganize data, similar to defragmenting a hard drive. Trim is supported in Windows 7 and 8, and in all modern SSDs.

ASYNCHRONOUS VS. SYNCHRONOUS FLASH

You'll see this in an SSD's specs, and the bottom line is that asynchronous flash is not as fast or expensive as synchronous flash, so it's not uncommon to see it in value drives, while synchronous flash is used in high-performance drives. Synchronous flash processes data roughly twice as fast as asynchronous, on both ends of the clock cycle, so you get two outputs per cycle, while asynchronous is not synced to the clock speed of the processor, so you can expect lower performance.

IOPS

This spec shows how many operations per second the drive is capable of performing. This differs from read/write speeds in that it's not measuring the speed of the writes or reads, but the number of them. This is typically used in situations where heavy random workloads are needed, simply because, in our opinion, it sounds better to say 85,000 IOPS than 30MB/s.

SEQUENTIAL READ/WRITE SPEED

This is how fast a drive can read and write contiguous data, sort of like an elephant inhaling a row of peanuts. This is often used as a metric for benchmarks because it measures "straight-line speeds" but is not indicative of real-world performance, as data is rarely written or read in this fashion.

SECURE ERASE

Old blocks of data on an SSD have to be erased before new blocks can be written to it, which takes time, so the fastest an SSD will ever be is the moment it comes out of the box and is totally empty. Unfortunately, even if you deleted everything on the drive, the data is still there, so it will still need to be erased if you want to write over it (Trim does this to some extent but not completely). The only way to totally wipe a drive of all its contents is a Secure Erase, which completely deletes all data on a drive. This is the most common way to get an SSD back to its fastest possible state, and is accomplished via software included with your drive (see next page).

THE DOWNSIDE OF USING TRIM

The Trim command has been made into something of a living legend in Windows 7 and 8, because it is so crucial to keeping an SSD optimized via garbage collection and the deletion of data that is no longer needed. Since SSDs require a data block to be erased before it can be written to, it's important to have that deletion occur before the data needs to be written, otherwise the whole process gets bogged down with multiple operations instead of just a simple write command.

There's a big downside to keeping your drive optimized, though, which HDD users don't have to contend with: If you accidentally delete a file and then try to undelete it via recovery software such as File Scavenger you may be out of luck. That's because Trim, or even the drive's own firmware, may have already deleted the data forever. More disturbing is that Trim can be executed at any time—its schedule isn't transparent to the user—so 10 minutes after you've deleted the file, it might already have been purged.

If you are a serial file-bungler and find yourself in constant need of file recovery, consider disabling Trim to buy you a little more time to recover inadvertently deleted data (at the cost of overall performance). Windows 7 users should also consider leaving system protection on, which will, on occasion, make copies of files. Windows 8 users should enable the File History feature that makes real-time backups of files on a secondary drive for you.

THE SOFTWARE SIDE

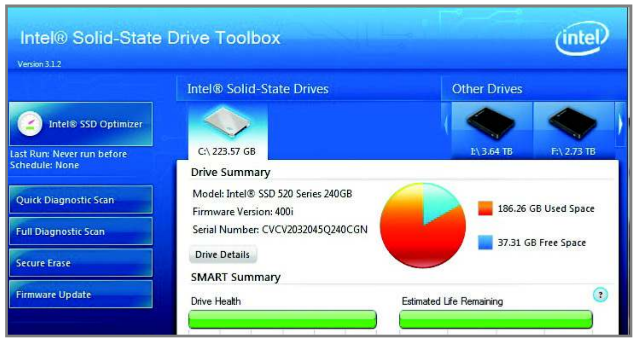
SSD utilities can make all the difference to your drive's overall functionality

Though most people install an SSD and never give it a second thought, free software makes it possible to monitor, optimize, and tweak a drive's performance. Samsung, Intel, and OCZ SSDs come bundled with free utilities, and you can use the free CrystalDiskInfo (http://bit.ly/UKzt0) with any SSD on the market. Here's a quick peek at what each one offers.



SAMSUNG SSD MAGICIAN 4.0

It's hard to believe, but not only does Samsung make arguably the best SSDs available right now, but it also makes the best SSD software, as well. Right on the home screen you can see how much data has been written to the NAND, its status, your interface speed, and more. If your OS doesn't support Trim, you can click "performance optimization" to Trim the drive manually. You can also update the firmware, adjust over-provisioning space, and more. Samsung regularly updates its software, too, making the choice to invest in a Samsung SSD that much easier.



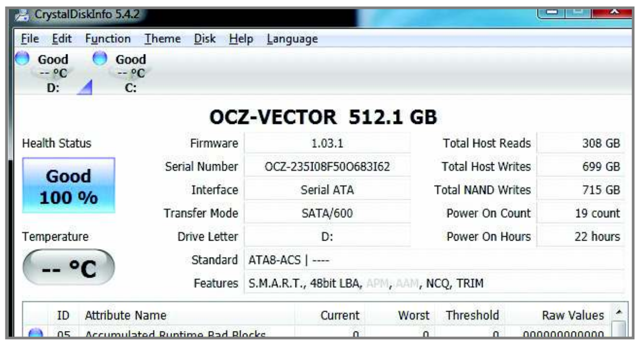
INTEL SSD TOOLBOX

Intel's toolbox software is easy to use, full of information, and tells you right on the home screen what the drive's health status is at the moment. Diving deeper into the menus will let you update the drive's firmware, perform a secure erase, run diagnostic scans on the drive, run the Trim command, and it will show you how to fully optimize the drive with your OS. If you're super-nerdy you can also choose to examine the drive's SMART data and details, but the whole point of the simple interface is to show you all that data in an easy-to-digest fashion. Still, it's all there if you really want to see it.



OCZ TOOLBOX V4.3

OCZ's free Toolbox software is basically the equivalent of a three-blade Swiss Army knife, in that it only lets you do a few things with your SSD. It's actually strange that OCZ would spend time and money to develop a software tool, then populate it with so few options, but since it's free software we're not complaining too much. The tool gives you the ability to check for firmware updates and apply them, and perform a secure erase of the drive; it will also spit out the drive's SMART data in the most unfriendly manner we've ever seen, so have fun translating it. This utility is helpful for updating your drive's firmware but not much else.



CRYSTALDISKINFO 5.4.2

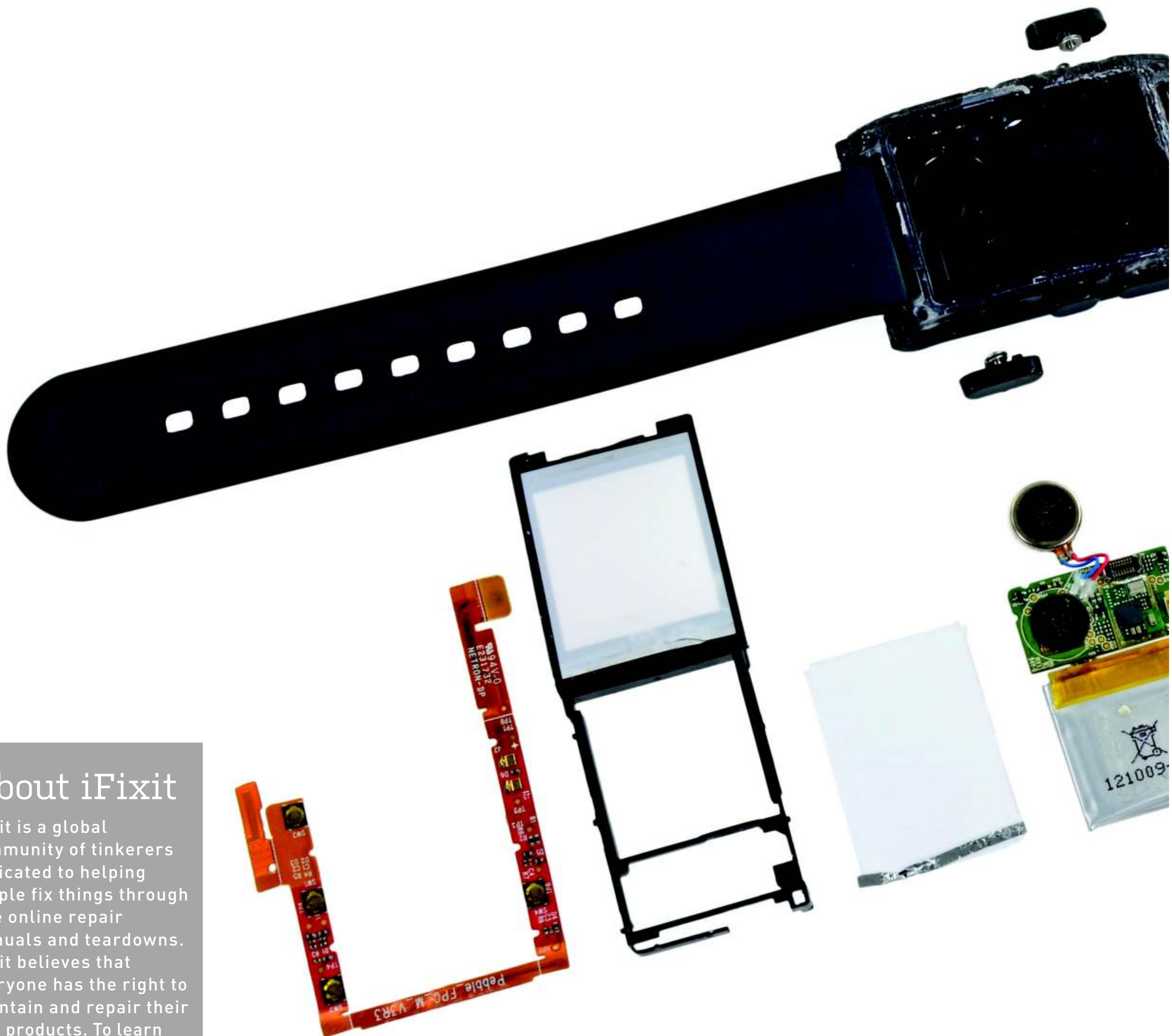
This is a free utility that should be able to read the SMART data from any SSD and give you an indication as to the drive's health, information about its activity, and more. One field to pay attention to is Total NAND Writes, as that will give you an indication of how much has been written to the drive if you like to keep tabs on those things. It also displays the current firmware version, SATA transfer mode, which features are enabled, and all the SMART data, as well.

iFixit presents:

AUTOPSY

THIS MONTH WE DISSECT...

Pebble E-Paper Watch



About iFixit

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products. To learn more, visit www.ifixit.com.



BACKGROUND:

The Pebble E-Paper Watch is the "first watch built for the 21st century," according to its maker. It can track your bike rides, display your text messages, and even tell the time! We had no choice but to bust open the Pebble and see what makes it tick.

MAJOR TECH SPECS:

- 32Mb serial flash
- STMicroelectronics high-performance ARM Cortex-M3 MCU, with a maximum speed of 120MHz
- STMicroelectronics three-axis accelerometer with gesture detection
- 144x168-pixel black-and-white e-paper display
- Bluetooth 2.1+ EDR and 4.0 (Low Energy)
- Vibrating motor

KEY FINDINGS:

- Pebble employs tons of adhesive to keep water—and tinkerers—out. With plenty of elbow grease and our iSesamo opening tool, we managed to part the case, leaving the stubborn smartwatch in only slightly better condition than if we had bombarded it with actual pebbles until it popped open.

- The Pebble makes use of a new Sharp Memory LCD that puts it in the realm of e-ink and e-paper.

- The Pebble innards are housed in a single simple assembly, boxed within a light plastic frame. A ribbon cable around the perimeter houses all four watch buttons, the three display LEDs, and the Bluetooth 2.1 antenna, so replacing any individual component will be impossible.

- Removing the backlight guide panel from the device grants access to the motherboard/battery/vibrator assembly.

- The back of the motherboard hosts a Panasonic RF module, providing the Pebble's advertised Bluetooth and Bluetooth Low Energy (BLE) functionality, powered by a Texas Instruments Bluetooth Controller.

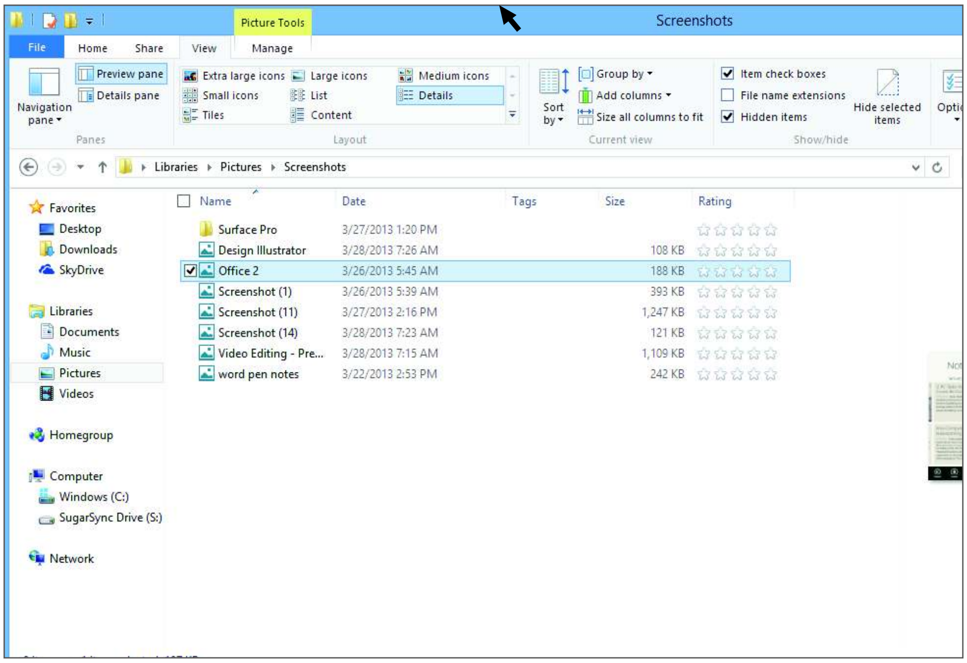
- The Fullriver battery is rated at 3.7 volts and 130 mAh. According to the GetPebble website, the battery is rechargeable via included USB charger, and lasts for over seven days on a single charge.

- Given the newness of smartwatches, we don't have a repairability metric for them... yet. In lieu of a numeric score, we'll list a few of our repairability and durability findings:
    - Low power consumption decreases the frequency of charges, increasing the battery life.
    - Watch band is a standard size and easily replaceable.
    - Inaccessible battery limits life of the device to 6–10 years (by our estimates).
    - It is impossible to open the device without destroying it or at least compromising its waterproofing, making internal repairs impracticable.

HOW TO

STEP-BY-STEP GUIDES TO IMPROVING YOUR PC

WINDOWS TIP OF THE MONTH



CUSTOMIZE THE FILE EXPLORER

Windows 8's file explorer uses a ribbon UI similar to recent versions of Microsoft Office, which exposes a lot of useful customization options. Click the View tab up top to choose icon types, view hidden files, enable/disable optional panes, and more.

MAKE - USE - CREATE



62 Start a Minecraft Server



64 Make Video Conference Calls for Free



ALEX CASTLE
CONTRIBUTING EDITOR

PIN ALMOST ANYTHING TO WIN8 START

FOR ME, the jury's still out on the Windows 8 Start screen. I think it looks terrific, and it's a blast to use on my Surface Pro's touchscreen, but it can be hard to keep organized. As I add programs to my system (and as someone who writes about software for a living, I tend to install quite a few), the Start screen gets overwhelmed with tons of icons and requires constant grooming. And sometimes, when I want to pin something, it's not clear how to do it. For instance, there's no obvious way to pin a commonly used settings window.

One good trick to keep in mind is that you can create a shortcut to anything that opens in the file explorer, which includes Control Panel settings items. Just copy the path from the navigation bar at the top of the explorer, then right-click your desktop and click New > Shortcut, and paste the path into the Target field. Now you can right-click the new shortcut and pin it to the Start screen.

↘ submit your How To project idea to: comments@maximumpc.com

Start a Minecraft Server

YOU'LL NEED THIS

A MINECRAFT ACCOUNT

This isn't going to work if you haven't purchased Minecraft. Get it at www.mojang.com.

A SPARE PC

It's best to run the server on a machine you're not going to want to run the client on at the same time.

MINECRAFT IS TWO games in one. There's the solitary survival game, where you plunge into a digital wilderness like a cuboid Bear Grylls and punch trees, and there's the multiplayer game, where you compete to build the largest pixel-penis and nudge your chums into lava for a giggle. If you've only played the former, you owe it to yourself to experience the latter. It's Minecraft on a completely different level.

Imagine collaborating on builds with someone else on a Creative server; it'll take half the time to create Mount Phallus than it might have done alone, or even less if you get more hands involved. A multiplayer survival server can be great fun—the quest to defeat the Ender Dragon is much less of a slog if you're all turning up pearls—and one with PVP enabled is even better. Here's how to get started. –ALAN SMITHEE

1 SET UP THE SERVER Before we wade in, we'll presume you've run Minecraft before. This means you'll have the latest version of Java installed—preferably the 64-bit version, if you're running a 64-bit system. This should be Java version 1.7 or higher. You can find out which version you're running by opening a command prompt window (Windows key + R), typing **cmd**, hitting Enter, and typing **java -version**. If an error is thrown up, or an older version number is displayed, head over to Oracle's Java download page (www.java.com/en/download) and snag the latest update. Bear in mind while you're installing it that it will suggest you might want to install the Ask toolbar. You don't want to do that, really. Uncheck the appropriate box.

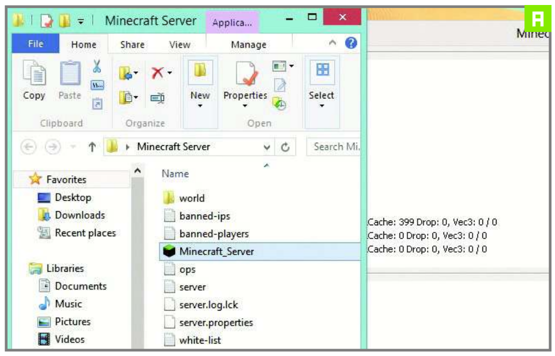
» If you are still having trouble identifying your Java version, you may need to set a system path to the Java installation folder. Right-click Computer, choose Properties > Advanced tab, and then click Environment Variables, and append C:\Program Files\Java\jre7\bin to the end of the Path list to ensure that you can access Java from anywhere on your PC.

» Minecraft's server software runs in Java, just the same as its client. It had better, given the amount of time we just spent making sure Java was running properly. Unlike the client, though, there's no pretty cuboid interface to play with. You'll have to make changes in a text file, and if you want to play on a locally hosted server, you'll need to run the client separately. As you'll see, though, hosting your own Minecraft server isn't nearly as tricky as it might seem at first.

» It's actually really easy to start a Minecraft server on your local network. You'll want to start by grabbing the server-specific packages from publisher Mojang. Just head to www.minecraft.net/download and get the simple Minecraft_Server.exe file. Once it's downloaded, give it its own folder somewhere you can find it.

» Right-click the executable and run it as Administrator. You'll soon see the reason we give it its own folder: Running it the first time generates a whole heap of additional configuration files and level data (image A), which we'll want to keep neat and tucked out of the way. It'll create a new world with a random seed, and just like that, you've got a server going.

» To prove to yourself that it's working, fire up the Minecraft client. You'll have to have actually bought the game to do this. Choose the Multiplayer option, Direct Connect, and use the address 127.0.0.1 (image B), which is the universal IP for "this machine." Local machines on your network should be able to connect using your computer's IP.



A



B

2 OPEN UP TO THE WEB Running a server on your local network is one thing; opening that server up to the Internet is quite another. For starters, the terms of your broadband contract may preclude you from running any kind of gaming server from your home.

» We can't really help you there—apart from suggesting a third-party server solution—but if you're OK to do it, you'll need to configure your router to forward your ports appropriately. Find out the local IP address of the machine on which you're running the Minecraft server (and make it

static, if you can), and make sure all connections to your router on port 25565 go straight to your server machine. Use www.portforward.com to find the specific instructions for your particular router.

» We'd recommend, before you allow anyone to connect to your router directly, obfuscating your external IP address. Portforward.com shows your external IP on its front page; copy this down, and head to www.no-ip.org to sign up for a free IP-forwarding address. Send this to your online friends, and they'll be able to connect to your PC with no knowledge of your IP.

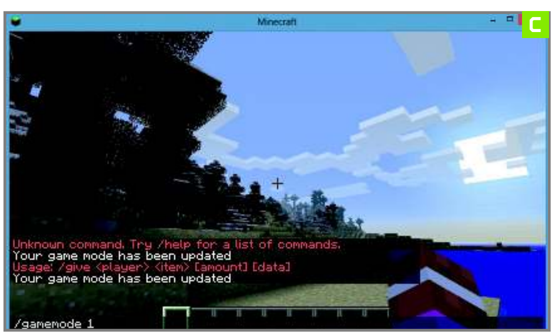
3 MASTER YOUR DOMAIN Being the owner of a Minecraft server means one thing first and foremost: giving yourself godly abilities beyond the reach of mere mortals. Shut down your server, then open the file in its directory called ops.txt. Stick your username in here, save it, then run the server again. Test it out by changing your gamemode—hit / and type **gamemode 1** (image C), and you should enter creative mode.

» One of the most useful commands as an op is give; you can use it for a sneaky cheat or to give items that can't be legitimately obtained by other means. There's a list of item values on the Minecraft wiki (http://bit.ly/ZpWEaV). Try it: Give yourself one monster spawner with **/give <nickname> 52 1**, or a stack of diamonds (always pretty useful) with **/give <nickname> 264 64**.

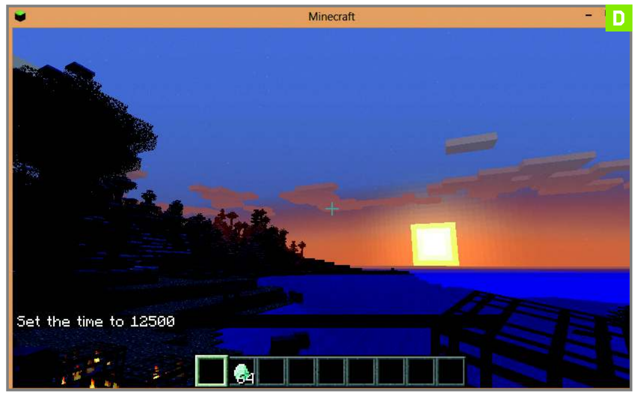
» Wouldn't it be great to have control over the sun and the moon? Perhaps the winter wouldn't be quite so harsh if we could just type **/time set day** to make it immediately sunrise, **/time set night** to make it sunset, or use any value between 0 and 25,000 to set the time more specifically (image D). It affects everyone connected to your server, so use it lightly—people will know you're messing around with the server!

» Chances are you're running a private server for your friends rather than a public one. Use **/whitelist on** to set up whitelisting, where only people with approved usernames (and those in the ops file) are allowed to connect (image E). Then type **/whitelist add <nickname>** to insert a friend's name on the list, **/whitelist remove <nickname>** to get rid of them, and **/whitelist list** to, yes, list who's on the list.

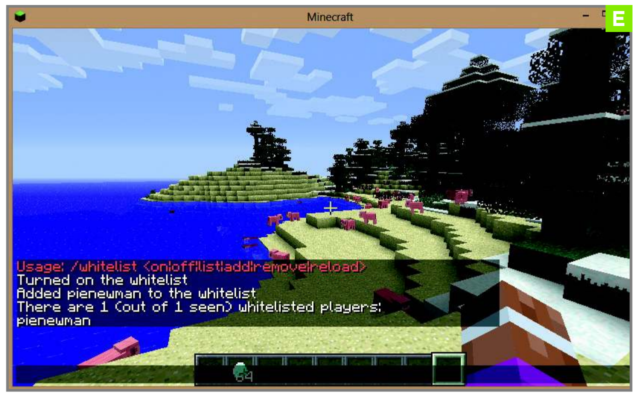
» If you're on the blacklist, you're not coming in. Use /**ban <nickname> [reason]** to add them (image F), or **/banip <ip address>** to ban a particular machine. If you're messing with a pal, **/kick <nickname> [reason]** boots them off of the server temporarily. To take someone off the blacklist use **/pardon <nickname>**.



C



D



E



F

Make Video Conference Calls for Free with ooVoo

YOU'LL NEED THIS

OOVOO
Get it at www.oovoo.com, or your app store of choice. You'll also need to sign up for an account.

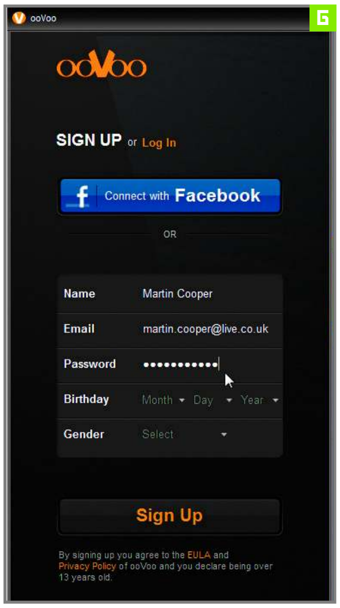
A GOOGLE ACCOUNT
If you want to upload group chats to YouTube, you have to have a Google account.

SKYPE, LIKE Hoover and Google, is one of those company names that has become a verb. People say, "I'll Skype you in half an hour!" and you know exactly what they mean. On the off chance that you're not familiar with Skype, it's a VoIP service from Microsoft—that is, a telephone service that lets you make voice and video calls over your Internet connection. It's loved by millions because it lets you make calls or have video chats between PCs for free, no matter where you are in the world. If you want to make a call from your PC to a telephone, you can do so by paying a few cents per call for what's known as the "last mile."

If you want even more from your VoIP telephone system, you should take a look at a service called ooVoo. It lets you make VoIP telephone and video calls to PCs, Android devices, Macs, and Apple tablets, too. What's more, it will let 12 people share a group video call for free from any PC, tablet, or smartphone. Skype and ooVoo aren't compatible, so you'll need to get your friends to sign up. We'll show you how to set up and use ooVoo. –**MARTIN COOPER**

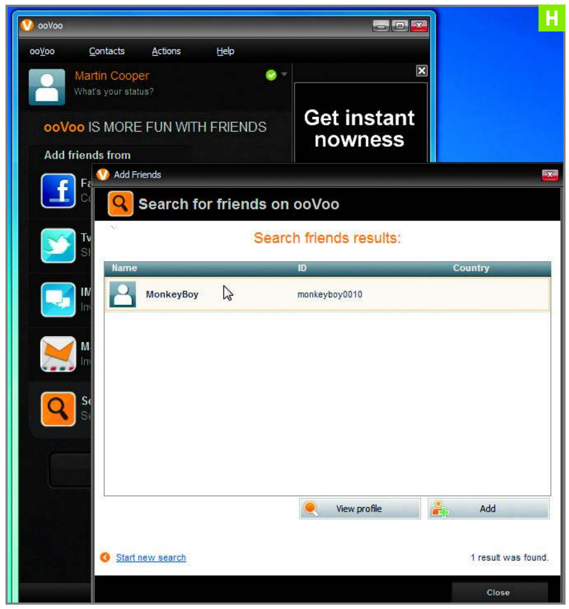
1 GET SET UP Go to www.oovoo.com, and click Get ooVoo to download the installer. There's nothing too complicated during the install process—just the normal language options and such—but it does try to slip an Ask toolbar install by you, so make sure to keep an eye open and uncheck those boxes. When the process has completed, click Finish.

» Next up, you'll need to create an ooVoo account. If you're a Facebook member you can use the details it holds to access ooVoo. Just click Connect with Facebook and enter your usual security details. Alternatively, fill in the form in the center of the screen and click Sign Up (Image G). As always, it's a good idea to choose a password that contains a mix of letters and numbers.



» When it comes to VoIP, there's a good chance your friends use Skype, though some may prefer to use Apple's FaceTime. Sadly, ooVoo isn't quite so well known. You'll need to contact your friends, tell them you're a member, and suggest they also sign up. There are Facebook and Twitter options in the program to broadcast news of your membership, if you're the social networking sort, or the option to send someone an email that will make it easy to sign up for ooVoo.

» Once your friends have joined ooVoo, you'll need to add them to your address book by searching for their user name and clicking the Add button (image H). You'll need to repeat this process for all your friends, and of course on their end, your friends will need to accept your request by clicking Add when prompted. As we've said previously, the good thing about ooVoo is that it works on all versions of Windows, Apple devices, and Android. So no matter which device your pals use, there's every chance you'll be able to video conference with them, unlike with competing services like Google Hangouts.

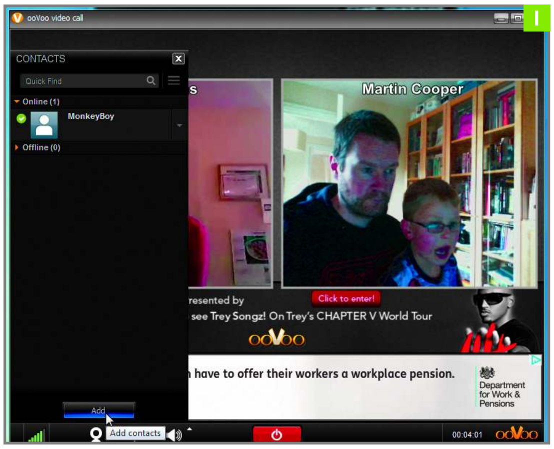


2 MAKE A CALL To begin a call, click Actions at the top of the screen and then click Start a Web Call. Your webcam should now spring to life and you should see yourself in the center of the screen. Now click Add to Call and then Contacts. These are the ooVoo contacts you've just made. Select your friend and click Add (image I). When they answer, you'll be able to chat.

» Adding more of your ooVoo friends into your conversation couldn't be easier. All you need do is move your mouse into the ooVoo windows and then when the menu options appear at the top of the screen, select Add to Call. Now, once again click Contacts, find your other friends, and invite them to join in (image J).

» We found that as you add more and more people to the

call, picture quality can start to degrade. The best way to ensure that everything keeps working smoothly is to ask your friends to stay in one spot, if possible. ooVoo's compression algorithm pushes more data across as more stuff in the video call changes, so someone using a smartphone outside and moving around will use up a lot more bandwidth than someone sitting in one place in front of their computer. You'll also need to be disciplined about taking turns speaking—12 people trying to talk over each other on a video call gets overwhelming quickly. When you're done, just click the red button to end the call.



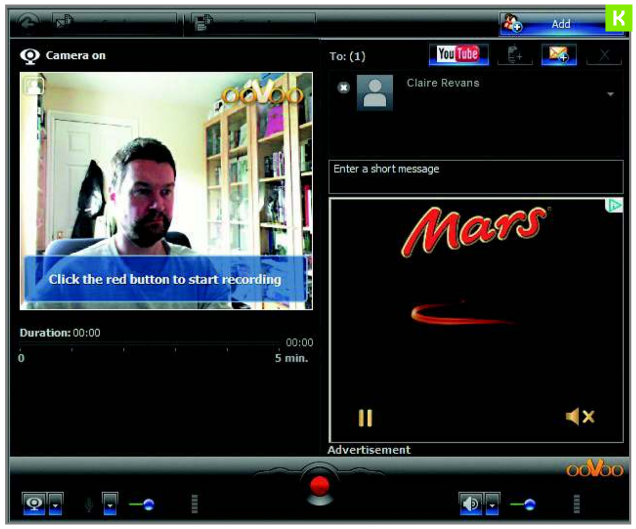


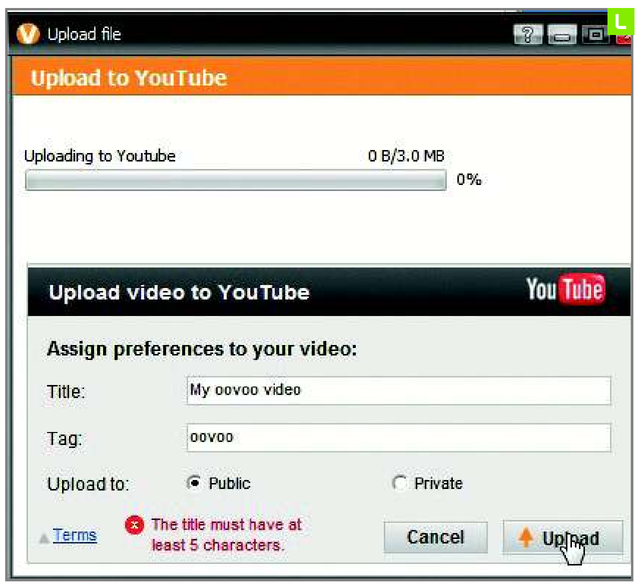
3 OTHER OOVOO FEATURES

OTHER OOVOO FEATURES If your friend is offline, you can leave a video voicemail message. When they log on, they'll be notified and can watch your small film. With ooVoo running, click the small icon that shows a film emerging from an envelope. Now, click the red record button (**image K**). When you're done, click the blue stop button. Now, at the top-left of the Window, click Send. It's as easy as that.

» One of ooVoo's coolest features is the ability to record a conversation and upload it to YouTube. This is a great way to document and preserve group chats, and can even be a good way to record an impromptu group presentation or podcast. When you're all logged on, ready, and chatting, move your mouse onto ooVoo, click Actions, and then Record. When you're done, click Stop.

» To share your conversations via YouTube, you'll need an account. If you have an account with Gmail or any other Google service, that same account will work for YouTube. Assuming you have one, click ooVoo > History > Recorded files. Now, select your conversation file and then YouTube Upload. There will be a brief pause while your video is processed (**image L**). Enter your YouTube username and password. You'll be prompted to title and tag your video, then click Upload.





BUILD IT

TOM MCNAMARA **ASSOCIATE EDITOR**



Squeezing the Titan into an ITX Case

Nvidia's newest GPU was built to provide maximum horsepower to SFF rigs, so we built a Mini-ITX system to see if the card would fit, and if it could keep cool and quiet under pressure

LENGTH OF TIME: **4–6 HOURS** | LEVEL OF DIFFICULTY: **INTERMEDIATE**

THE MISSION Nvidia's GeForce GTX Titan video card has a serious cool factor. It's the fastest single-GPU card on the market, for one thing. And it beats the competition without sounding like a fighter jet or getting hot enough to trigger a meltdown. Finally, at 10.5 inches, it's shorter than the reigning single-card champ, the GTX 690, by half an inch, making the Titan suitable for deployment in small form factor (SFF) builds. In fact, when Nvidia launched this card, it specifically pointed out that it was designed for use in SSF rigs, so we just had to see how things would play out in a Mini-ITX environment. And why stop with the card? We figured we might as well throw in a nice CPU, motherboard, a fast SSD, and some extra cooling so we could dabble in overclocking. Even though we started off with the innocent goal of gauging the experience of building a Titan-based SFF rig, in the end we decided to see just how far we could push this tiny system, and came away surprised by how much performance can be had in a rig with such a small footprint.



A PLETHORA OF OPTIONS

WITH OUR GPU already decided, we had to figure out which platform to build around, and going Mini-ITX narrowed our choices considerably. First off, there are no LGA2011 motherboards in that form factor, and second, Intel's new socket 1150 Haswell microarchitecture isn't available as of press time, leaving just AMD or Intel's venerable Socket 1155. Because this is a maximum-performance machine, we went with Intel, especially since we wanted to overclock and we know from experience that we can push a Socket 1155 CPU to 4.4GHz. That push necessitated a large CPU cooler and an overclockable motherboard.

To hold it all, we chose Silverstone's Sugo SG08 case. It's small and tastefully appointed, yet large enough for both our Titan GPU and an aftermarket CPU cooler since its PSU is mounted in the front of the box instead of the rear. There are larger SFF cases that offer more room for fans and wiring, but we wanted to see the Titan sweat a bit, so we went with the Sugo. We also like the fact that it includes a 600W power supply that's customized for the chassis; a very nice touch that we'll discuss later on in more detail.

Wrapping it up we chose an OCZ SSD for our OS drive and a WD hard drive for media storage. We went with a slot-fed optical drive since that is the only type this case accepts and we didn't want the bay to sit empty. Finally, we used a low-profile Silverstone Nitrogon NT06-Pro CPU cooler and Windows 7 Pro.

INGREDIENTS

	PART	URL	PRICE
Case	Silverstone Sugo SG08	www.silverstonetek.com	**$200**
PSU	600W SST-ST60F-SG		**(bundled)**
Mobo	P8Z77-i Deluxe	www.asus.com	**$200**
CPU	Core i7-3770K	www.intel.com	**$325**
Cooler	Nitrogon NT06-Pro	www.silverstonetek.com	**$60**
GPU	GeForce GTX Titan	www.nvidia.com	**$1,000**
RAM	2x 8GB Vengeance	www.corsair.com	**$100**
SSD	256GB OCZ Vector	www.ocz.com	**$250**
Hard Drive	2TB WD Caviar Black	www.wdc.com	**$150**
OS	Windows 7 64-bit OEM	www.microsoft.com	**$100**
Optical Drive	Samsung SN-208DB/BEBE	www.samsung.com	**$22**
Total			**$2,407**

1 ITX-CELLENT

AN ASUS P8Z77-I Deluxe is an expensive board, but you are reading *Maximum PC*, after all. The mobo is loaded with beefy overclocking options, built-in Wi-Fi, USB 3.0 front-panel connectors, and eSATA; it's just as full-featured as mobos twice its size. Asus manages this feat partly because it added an extension called a "riser," which holds extra capacitors and other circuitry, effectively extending the board's size vertically (**image A**).

We installed the CPU cooler's backplate before installing the motherboard, as the case has no opening behind the motherboard. The heatsink on the north bridge also has a plastic fastener that we needed to push up a little, to make the CPU backplate fit securely against the motherboard. The board's riser card also has two screws that need to be removed, then re-installed after the motherboard is inside.

2 COOL CUSTOMERS

CPU COOLERS like Silverstone's NT06-Pro are designed for use in chassis like this, where the power supply is not installed over the motherboard, leaving a bit of room over the CPU for some additional cooling power. This heatsink is oriented parallel to the CPU instead of sticking up like a tower cooler, so it fits into tight spots where tower coolers won't. To make the NT06-Pro fit, we initially pointed the tips of its heat pipes towards the PCIe slot, but they were actually blocking it slightly, so we adjusted them to face the rear of the case (**image B**). The CPU fan went on top, blowing air down through the heatsink and complementing the positive pressure airflow from the 18cm case fan right above it. Installation was simple and took only 10 minutes, which included adjusting the orientation of the heatsink. We could have flipped the case fan and used it as an exhaust instead (ideally flipping the CPU fan as well), but this creates "negative" pressure (a slight vacuum), which usually leads to higher temps.

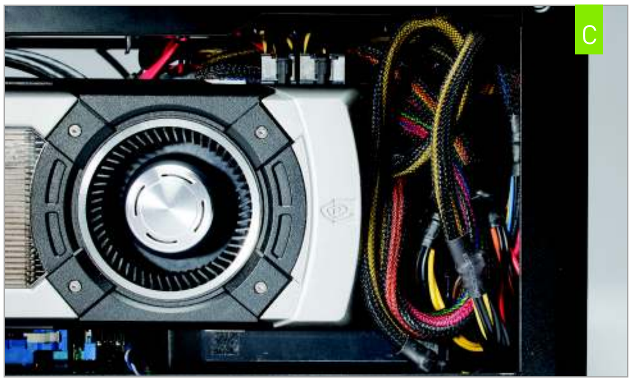




3 GODLIKE PROCESSING UNIT

NVIDIA'S GEFORCE GTX Titan is basically the star of the show here. The SG08 case can technically fit a GeForce GTX 690, which costs the same as the Titan while outperforming it by as much as 20 percent. But dual GPUs means SLI, and that can be glitchy, which is why people prefer single-GPU gaming. The 690 is also noticeably louder under load than the Titan, and it produces substantially more heat.

To install the video card, we could have gone in from the top or the side. But we chose to go in from the side, at an angle, in order to make sure no cables got trapped below the card. And because the Titan is just 10.5 inches long in a case that can handle 12.2 inches, there was space between the end of the card and the front of the case to hide the power supply cables (image C).



4 DRIVE ME CRAZY

THE 256GB OCZ Vector is our SSD of choice this time. You could save money with a Corsair Neutron GTX, but the price difference is tiny against the system's overall price tag. In our tests, the Samsung 840 Pro is a smidgen faster than the Vector, but it's close enough that the subjective difference between the two is nonexistent. The SG08's drive cage leaves just enough room to slip two SSDs under the hard drive (image D), though we felt compelled to put the Vector in upside-down to orient its SATA cable more comfortably.

A 2TB Western Digital Caviar Black was also installed to give us much-needed capacity. The drive cage is not toolless however, so a screwdriver is required for installation. Also, the Silverstone SG08 can only fit a "slim" optical drive (normally seen in laptops), but the Samsung was only $22. It needs a special combined power and data connector cable, which Newegg had for a few bucks.



5 DOWN TO THE WIRING

THE SG08'S BUNDLED 600-watt power supply has shortened cables that are specifically designed for the case (image E), so that made our job a little easier. It also has just one Molex cable, and one SATA power cable with three connectors on it, so you can only connect up to four devices. The Titan was a bit of a tight fit, but it was OK, and we had enough space to tuck the power cables away. Still, it's difficult to picture an 11-inch video card fitting inside this case, let alone a 12-incher. While the motherboard power cables are braided, the 24-pin cable is still thick and therefore stiff. It and the 8-pin power cable ended up getting looped a couple of times within the spare real estate we had left. The GPU power cables were unavoidably snug against the top of the SG08 when the case cover went on, though; flat cables would be ideal.

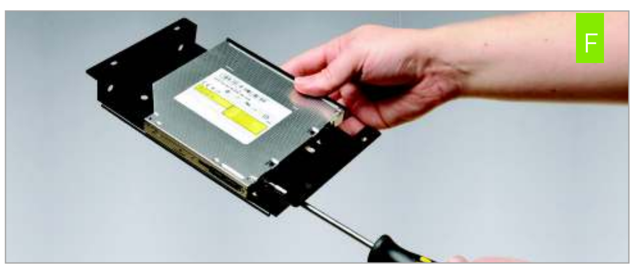
If anything, the biggest wiring problem we faced was with the three SATA cables we used, since they were all standard length. If we had planned better, we would have ordered some shorter cables to help reduce the clutter.

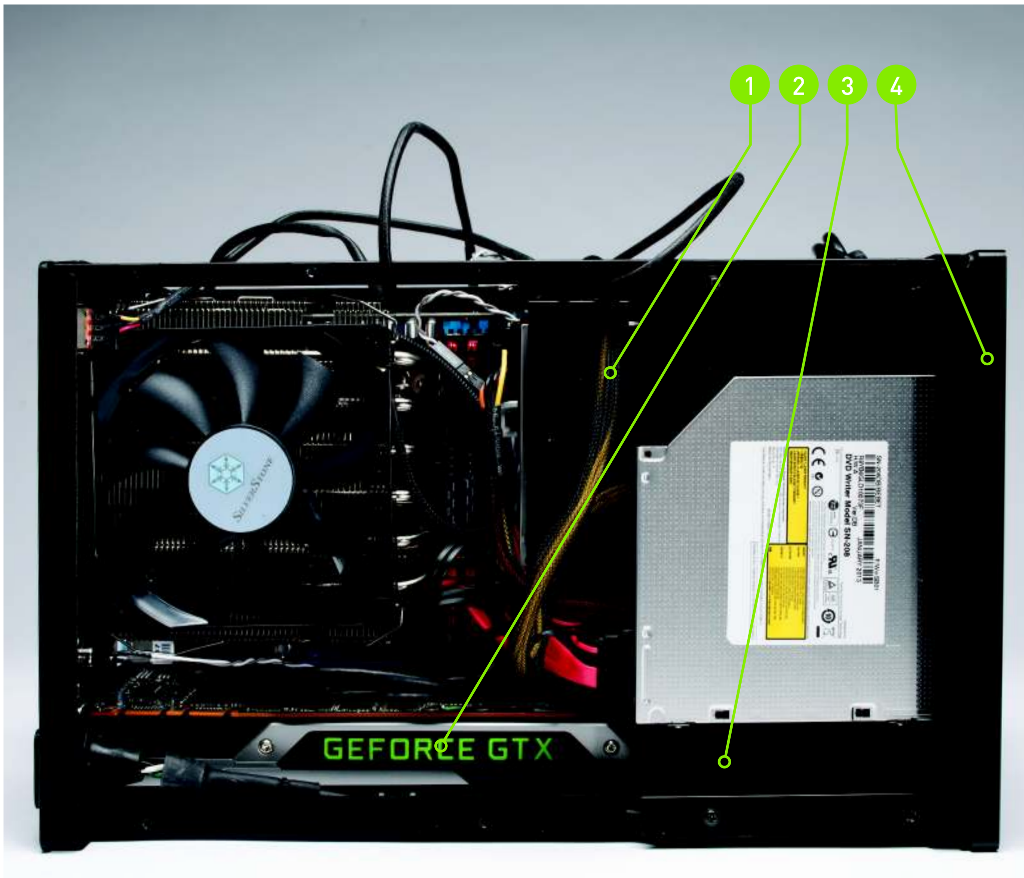


6 MISCELLANY

ASSEMBLING THIS build in the order dictated by the layering of components was a challenge. The GPU definitely had to go in last, because the motherboard's riser card obstructs access from the other side of the case. So, once the GPU is in it blocks access to the rest of the motherboard. If we had forgotten to plug in a cable somewhere, we would have had to pull out the GPU to solve the mystery, so it was important to be methodical.

We had to get a little creative with the cabling to get everything to fit. For example, the SSD and its right-angle SATA connector ended up going in upside-down because we were running out of room to thread the cable around the power supply. We went over the PSU instead, as there were several millimeters of space between it and the optical drive tray above. The optical drive also uses very tiny screws (image F), about the size that you'd see on a pair of eyeglasses. The SG08 comes with them, thankfully, but they took a while to insert because the drive tray is recessed (though it uses precut holes for you to align the screwdriver with the screw holes).





1. The included Silverstone power supply pushes 600 watts and has a reduced number of cables that are also custom-cut to fit perfectly inside a smaller chassis.

2. At 10.5 inches long, the GeForce GTX Titan fits just fine and leaves a little space to run cables in front of it.

3. The Sugo SG08's power supply is located in the front instead of the back, which opens up space for a large aftermarket CPU cooler—an impressive feat given its Mini-ITX form factor.

4. The front bezel of the case is designed for a "slim" optical drive, like the ones normally used in laptops.

THE LITTLE OVERACHIEVER IN ACTION

WITH OUR MINI-RIG assembled, cooled, and ready to rumble, we were primed to see how hard we could push these components. After all, the SG08 sports a large grill on the side, offering our GPU the chance to pull in cool air, so the Titan has some room to breathe. The case's unusually large 18cm "penetrator" fan blows directly down on the core of the system at up to 1,200rpm, and the CPU has a big heatsink with a 12cm fan that can go up to about 2,200rpm, so we figured cooling wouldn't be an issue. To our delight, the GPU handled a core overclock of 150MHz and a memory OC of 400MHz without complaints. The Titan did get up to 81 degrees C in our temperature-controlled Lab, which hovers around 20 C (or about 70 F), but Nvidia has told us the Titan is fine up to temps below 95 C. The Titan stayed fairly quiet and pushed almost all of its heat out of the system, too, which was excellent. So as far as the question of a Titan being able to survive in a SFF chassis goes, we'd say it works like a charm, and we can't see it causing any issues at all in other small cases.

You're probably surprised to see that this system's 3DM11 score of 5,571 was within 5 percent of our zero-point system, which boasts a hexa-core i7-3930K overclocked to 4.2GHz and a GTX 690. However, the 690 was not overclocked, and keep in mind the zero-point's GPU scores were achieved with the drivers that were out when it was built in March 2012, so much of the surprisingly small gap is probably thanks to Nvidia's constant software optimizations made since then.

The CPU was a trickier affair. Once you get beyond about 4.4GHz, Ivy Bridge CPUs start heating up dramatically. Taking it to 4.6GHz or even 4.5GHz gave us temperatures we didn't think would be sustainable outside of our air-conditioned testing environment. The NT06's bundled fan is also not particularly quiet once it revs up to about 2,200rpm, and the case fan adds noticeable noise when switched to "high." Even though we thought this little rig might be able to sit in our living room *and* stay quiet while gaming, we're left to conclude this particular setup would not be the best choice.

So, the overall system performance was excellent, the build quality of the case was great (though the bundled PSU could use shorter motherboard power cables), the motherboard handled our CPU overclock quite well, and we didn't have to do anything questionable or dangerous to fit everything into the SG08. Overall, we'd say the mission was accomplished. Now, to build a Titan SLI SFF rig....

BENCHMARKS

	ZERO POINT	
Premiere Pro CS6 (sec)	2,000	2,700 (-26%)
Stitch.Efx 2.0 (sec)	831	768
3DMark11 Extreme	5,847	5,571 (-4.8%)
x264 HD 5.0 (fps)	21.1	16.95 (-19.7%)
ProShow Producer 5.0 (sec)	1,446	1,336
Batman: Arkam City (fps)	76	80

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our current desktop test bed consists of a hexa-core 3.2GHz Core i7-3930K @ 3.8GHz, 8GB of Corsair DDR3/1600, on an Asus Sabertooth X79 motherboard. We are running a GeForce GTX 690, an OCZ Vertex 3 SSD, and 64-bit Windows 7 Professional.

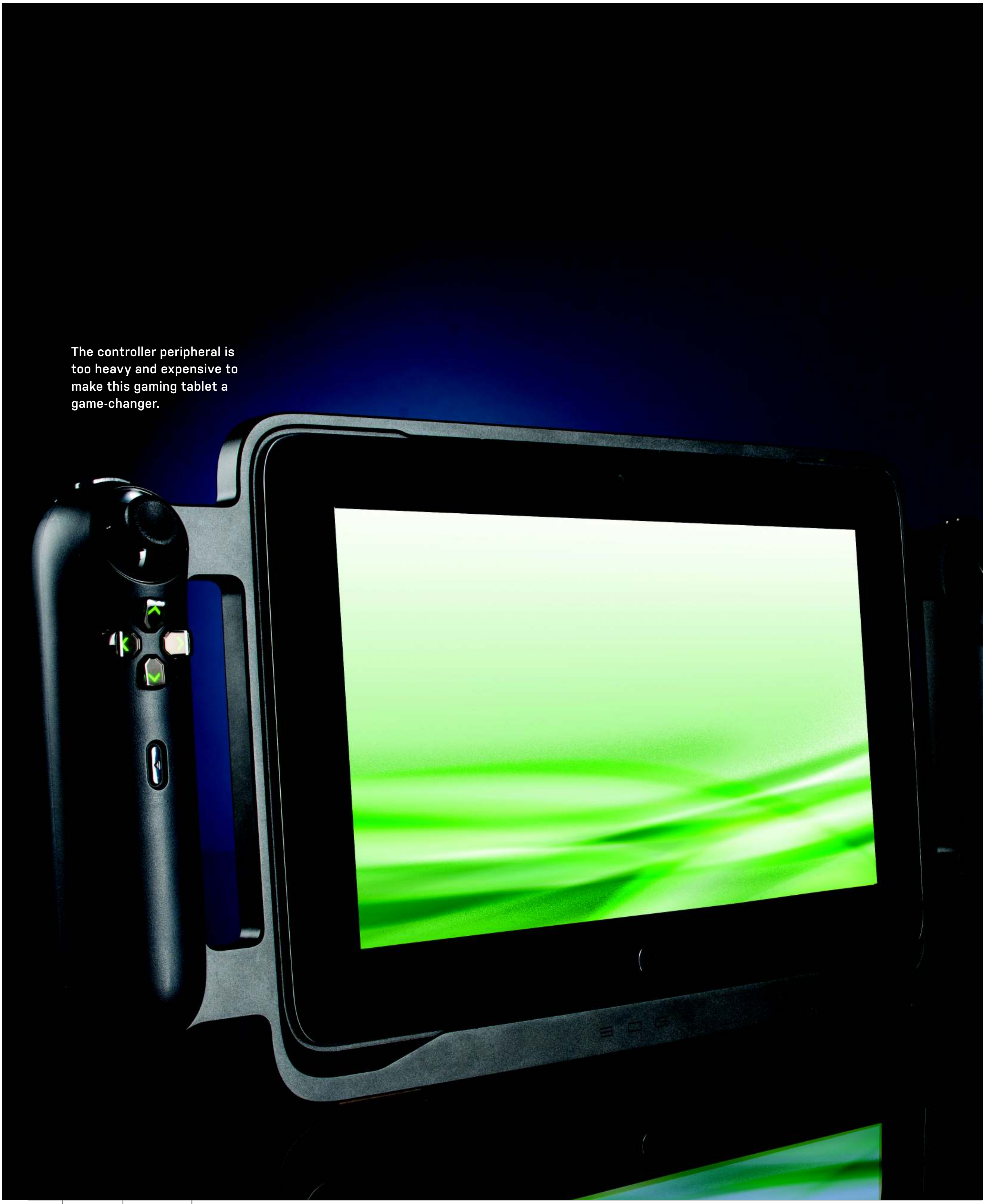
REVIEWS

TESTED. REVIEWED. VERDICTIZED.

INSIDE



GOOGLE PIXEL CHROMEBOOK
PAGE 78



The controller peripheral is too heavy and expensive to make this gaming tablet a game-changer.

Razer Edge Pro

It sounded so good on paper...



THE RAZER EDGE sounds fantastic: a Windows 8 tablet, notebook, and portable gaming system in one. But in actual use, the Edge is a letdown.

The Edge starts at $1,000, with the Pro (reviewed here) climbing up to $1,450. That may be pricey for a "tablet," but it comes with a Core i7-3517U, Nvidia GT 640M LE, 8GB of DDR3/1600, and a 256GB SSD. While it's supposed to be the happy love-child of a portable tablet and a powerful PC, the end result is a compromised monstrosity.

The first thing you'll notice about the Edge is its bulk. Measuring 10.9x7x.8 inches and weighing two pounds, 2.1 ounces, it's big, thick, and heavy for a tablet, basically requiring you to rest it on your body for support. This in turn muffles the otherwise excellent speakers, which are placed on the bottom edge. And flipping the Edge upside down isn't a great solution, as you might accidentally trigger the power button on the opposite edge.

Other external controls and ports include a volume rocker, auto-rotate lock, a virtual keyboard button, a USB 3.0 port, and a headphone jack. The intake and exhaust vents are quite large and often noisy; you'll hear the fans revving even when just web browsing.

The Edge's IPS screen offers fantastic viewing angles. While the glossy five-point touch display features just a 1366x768 resolution, its 10.1-inch screen still offers a decent 155.1-pixel-per-inch (PPI) density. Our MSI GT60's 15.6-inch screen has a 141.2 PPI, for example. We aren't fans of the thick one-inch bezel, though, as it made us wish we had Stretch Armstrong's thumbs.

Our biggest issue with the Edge, however, is that it lacks a physical keyboard. While Windows 8 might be better *with* touch, it sucks with *only* touch. Navigating through desktop mode was a headache because a lot of the tiny icons were clearly designed for the precision of a mouse/trackpad. Even if you were to hook up a Bluetooth keyboard/mouse, you still can't effectively use the Edge as a proper desktop PC because it doesn't have a stand. (An optional dock with additional ports could serve as a stand, at the added cost of $100.)

The Edge also had connectivity issues with our Linksys E1200 router, often disconnecting or running terribly slowly, and Razer acknowledged problems with Linksys routers in general. Belkin and D-Link routers fared better, but the download speeds were often a quarter of our zero-point's sitting a foot away.

The Edge didn't fare any better in our standard performance benchmarks. The closest it got to our zero-point in CPU-intensive tests was in ProShow, where the Edge's 1.9GHz-clocked CPU lagged just 22 percent. In our multithread-hungry x264 benchmark, it got crushed by 54 percent. In our GPU tests, it fell 14 percent behind in STALKER, and got severely beaten down in 3DMark 11. The Edge couldn't even keep up in the battery department!

At the end of the day, you shouldn't expect a tablet to perform on par with a beefy gaming notebook. (We're including the benchmarks for reference only.) The Edge was designed to run games on medium settings, and for the most part, it succeeds. We played Borderlands 2, an Unreal Engine game, and got a consistent 40fps. The Edge was actually able to max out Portal 2, a Source Engine game, with frame rates in the high 80s. On the more graphically demanding Far Cry 3, however, we saw a 31fps average, which tells us settings should be lowered.

If you're looking to play these games with the Edge's optional controller peripheral, you shouldn't, as the Edge ends up weighing four pounds, which is much too heavy. It's also overpriced at $250. The much-needed keyboard add-on also isn't available yet, nor is its price known. The dock mentioned above, meanwhile, is a necessity. For its $100 you'll get three USB ports, an HDMI-out, and a much-needed stand, but it lacks an Ethernet port.

While the Edge is much more usable if you purchase the right accessories, that drives up the price and limits its portability. You're better off purchasing a laptop to satiate your gaming needs and a Nexus 7 to get your portability fix—which you can do for about the same price of the Edge with all the peripherals it needs to be useful.

We really wanted to like the Edge, but the design limitations currently make this a better idea on paper. At present, this is one dull Edge. –**JIMMY THANG**

VERDICT 5

Razer Edge Pro

➕ **EDGE** Good boot times; powerful speakers; competent display.

➖ **WEDGE** No keyboard; need to buy peripherals; no kickstand; severe Wi-Fi issues.

$1,450, www.razerzone.com

BENCHMARKS

	ZERO-POINT	
Stitch.Efx 2.0 (sec)	1,092	1,568 (-30.4%)
ProShow Producer 5 (sec)	1,786	2,295 (-22.2%)
x264 HD 5.0 (fps)	12.0	5.5 (-54.2%)
STALKER: CoP (fps)	32.8	28.2 (-14%)
3DMark 11 Perf	2,979	1,563 (-47.5%)
Battery Life (min)	187	178 (-4.8%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our zero-point notebook is an MSI GT60 with a 2.3GHz Intel Corei7-3610QM, 12GB DDR3/1600, two 500GB Seagate 7,200rpm hard drives, a GeForce GTX 670M, and Windows 8 64-bit. STALKER: CoP tested at 1920x1080 with Ultra settings, Tessellation, and contact hardening.

SPECIFICATIONS

CPU	1.9GHz Intel Core i7-3517U
RAM	8GB DDR3/1600
Chipset	Intel HM76
GPU	Nvidia GT 640M LE 2GB GDDR3
Display	10.1-inch, 1366x768 IPS display (glossy)
Storage	256GB SSD
Optical Drive	N/A
Connectivity	1x USB 3.0, audio in, 2MP webcam, Bluetooth, 802.11n
Lap / Carry	2 lbs, 2.1 oz/ 2 lbs, 12.5 oz



As with the GTX 690, both EVGA and Asus offer Titans that are 100 percent Nvidia's design inside and out.

EVGA GeForce GTX Titan

Fastest single-GPU card? Yep. Fastest GPU? Nope



IF ALIENS ever land and say, “Take us to your single-GPU leader,” you’ll have to find a GTX Titan that’s available for a viewing. The Titan is without a doubt the fastest single-GPU card available today, but it’s not the fastest single video card, as that distinction still belongs to dual-GPU behemoths such as the Asus Ares II and the Nvidia GTX 690. A lot of people don’t enjoy messing with SLI and CrossFireX, though, and for them the Titan offers the highest level of performance possible at this time without any dual-card shenanigans. It also brings some new technology to the table, has a smaller form factor and lower TDP than the GTX 690, and includes heavily revamped tuning software designed for quiet operation, making it one of the most well-rounded and impressive GPU packages we’ve encountered in recent memory.

The Titan has existed for more than a year in the supercomputer world in the form of the Tesla K20X, which costs around $5,000. It’s Nvidia’s Big Kepler GPU, meaning it’s the most powerful implementation of the company’s current architecture, and for context it’s almost double everything compared to a GTX 680 GPU. It has twice the transistors, almost double the CUDA cores, triple the frame buffer, a wider memory bus, better double-precision performance for compute, and totally revamped tuning software. Given its massive parallelism and size, the card runs at a much slower clock speed than a GTX 680, however, moving along at 836MHz compared to the 680’s 1,006MHz clock speed. It’s a half-inch longer than the GTX 680, but is a worthy successor to the flagship cards we tested last year, as it offers a sizable performance increase over all of them—dual-GPU cards excluded, of course.

In terms of new technology, its tuning software now lets you dictate a maximum temperature for the card, which helps keep it totally silent at all times. Out of the box it’s set to 80 C but you can nudge it up to 95 C if you’re feeling saucy; the card can handle it. You can also overvolt the Titan, which is a first for a “stock” card from Nvidia. The GeForce GTX logo is now controlled by software, too, so you can make it breathe and tweak its brightness level. It will supposedly also let you “overclock” your display’s refresh rate, allowing you to bypass VSync to achieve higher frame rates.

In testing, we saw the Titan reign supreme over its single-GPU competitors, but it could not topple the Ares II, Radeon 7990 Devil 13, or GTX 690 cards. It’s also not as fast as dual-card SLI and CrossFireX configurations, which isn’t surprising, but the Titan is close to them despite using only one GPU, which is quite impressive. It also requires exactly half the power requirements, needing just one 6-pin and one 8-pin PCIe connector. Overall, it’s a good 10–15 percent faster than the GTX 680, which is great and all, but not for double the price.

In the end, the main goal of the Titan is twofold: to provide a kick-ass GPU to fit inside the increasingly popular SFF rigs, and to convincingly take the single-GPU crown back from AMD’s HD 7970 GHz edition. On both of these fronts it’s definitely Mission Accomplished, which can mean only one thing: It’s your move, AMD! –**JOSH NOREM**

BENCHMARKS

	EVGA GeForce GTX Titan	EVGA GTX 690	GTX 680	Asus Radeon HD 7970 TOP
3DMark Fire Strike	8,854	**9,448**	6,543	6,623
3DMark 2011 Performance	12,811	**15,195**	10,921	9,618
Unigine Heaven 4.0 (fps)	33.9	**38.9**	24	22
Crysis 3 (fps)	22	**31**	18.1	17
Shogun 2 (fps)	49	**61**	39.4	29
Far Cry 3 (fps)	39.3	**48**	30	26
Dirt 3 (fps)	100	**120.3**	79	77
Metro 2033 (fps)	26.3	**29.6**	17	19
Batman: Arkham City (fps)	97	**109**	66	64
Catzilla Beta	7,355	**9,837**	5,711	4,498

Best scores are bolded. Our test bed is a 3.33GHz Core i7 3960X Extreme Edition in an Asus P9X79 motherboard with 16GB of DDR3/1600 and a Thermaltake ToughPower 1,050w PSU. The OS is 64-bit Windows Ultimate. All tests are run at 2560x1600 with 4X AA except for the 3DMark tests.

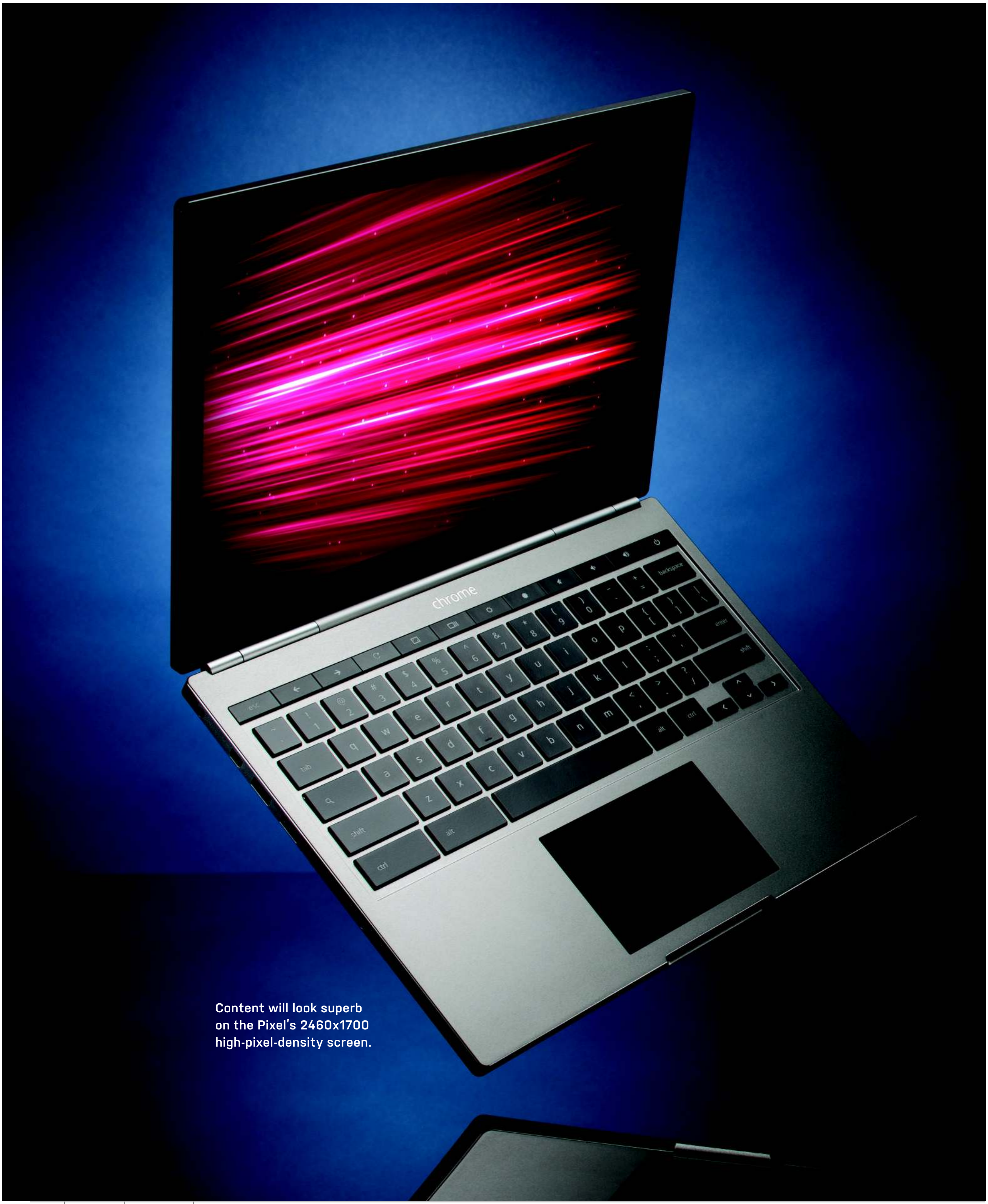
VERDICT **9** KICK ASS!

EVGA GeForce GTX Titan

+ GRUMPY CAT Fastest single-GPU available; surprisingly quiet; superb software; smallish form-factor.

− LIL’ BUB SLI/CrossFireX is still faster; not as fast as same-price GTX 690; super expensive.

$1,000, www.evga.com



Content will look superb on the Pixel's 2460x1700 high-pixel-density screen.

Google Chromebook Pixel

It's the Tesla Model S of laptops

AFTER ALMOST three years, it's still difficult to explain to techno-newbs just what the hell Google's Chrome OS and Chromebooks are exactly.

Browser-only OS? No, when we tell people that, we just get a slack-jawed look that tells us they don't understand what that even means. Instead, we've taken to using a car analogy to help explain the concepts.

A laptop with a full-service OS (whether Windows, Linux, or even OSX) is a truck with a sports car engine; it gives you mind-bending performance and cargo capability not available on any other consumer hardware. An ARM-based device is more akin to early hybrid vehicles. They give you amazing run time and portability, and the applications—for what they are—work pretty damned well when scaled down for the platform.

If that analogy holds up, the Chromebook is an electric car. It's fine when you have Internet access, but once you're offline, its capabilities plummet. It's like trying to drive your electric car across the United States—it's just not feasible at this point unless you want to stop every 250 miles and park the car overnight near a power outlet.

Well, kids, behold the Tesla Model S of personal computers: the Chromebook Pixel. Built on a stunning aluminum shell, the Chromebook Pixel is the sexiest Chromebook we've ever seen and easily one of the sexiest notebooks, too.

It's no clone/me-too notebook, either. Google eschews the popular 16:9 aspect ratio screen for a 3:2 aspect-ratio IPS multitouch panel. This makes the screen slightly taller than 99 percent of the notebooks out today. We appreciate the 3:2, but then again, we actually still pine for the days of the long-ago 4:3 aspect-ratio screens, so maybe we're just crazy. The screen itself is an incredible 2560x1700 pixels crammed onto 12.8 inches diagonal. That gives it a PPI of 239, which is the highest in the industry on a clamshell computing device. The etched glass and laser-honed track pad is simply stunning to use, too.

The LTE version reviewed here features 64GB of storage and gives you 100MB of data per month for two years. Pixel buyers will also get 1TB of Google Drive storage for three years. The Wi-Fi-only model cuts the storage in half and brings the price down to $1,300.

And proving that even for thin clients, performance still matters, the Pixel uses a 1.8GHz Core i5 processor, which makes a monkey out of all previous Chromebooks we've tested. On the graphics side, some may beg to differ with the performance of the Intel HD 4000 graphics (*cough* nVidia) but the combination outstrips any other Chrome OS notebook out today. You're probably wondering why you even need CPU performance for a browser OS that actually runs decently on even limp ARM chips. Frankly, our gut says Google has plans to use all the CPU horsepower in the Pixel on something. Don't believe us? Just Bing Google's 10,000 Stars experiment on your old Atom- or ARM-based Chromebook and you'll see what we mean.

Still, we understand what has led the majority of reviewers to label the Pixel the sexiest notebook no one should ever buy—its utility still falls far short of a full-service laptop. At the same time, there are a lot of a people who think the Tesla S is an impractical, overpriced electric car, too. That assessment is probably accurate, but there's no denying that the Tesla S is a damned-sexy car few of us would turn down. Same goes for the Google Pixel. –**GORDON MAH UNG**

BENCHMARKS

	Google Chromebook Pixel	Samsung ARM Chromebook	Samsung Series 5	Google CR48	Lenovo IdeaPad Yoga Windows 8
CPU	Dual-core 1.8GHz Core i5	Dual-core 1.7GHz Samsung Exynos 5	Dual-core 1.66GHz Intel Atom N570	Single-core 1.66GHz Intel Atom N455	Dual-core 1.7GHz Core i5-3317U
GPU	Intel HD4000	Samsung Mali-T604	Intel GMA3150	Intel GMA3150	Intel HD4000
SunSpider JavaScript 0.9.1 (ms)	**235**	710	1,380	1,296	**232**
Google Octane V1	**12,906**	3,359	2,026	1,959	11,772
FutureMark Peacekeeper	**3,773**	1,150	595	566	3,462
Microsoft Fishbowl HTML5 10 fish (fps)	**60**	**60**	6	5	**60**

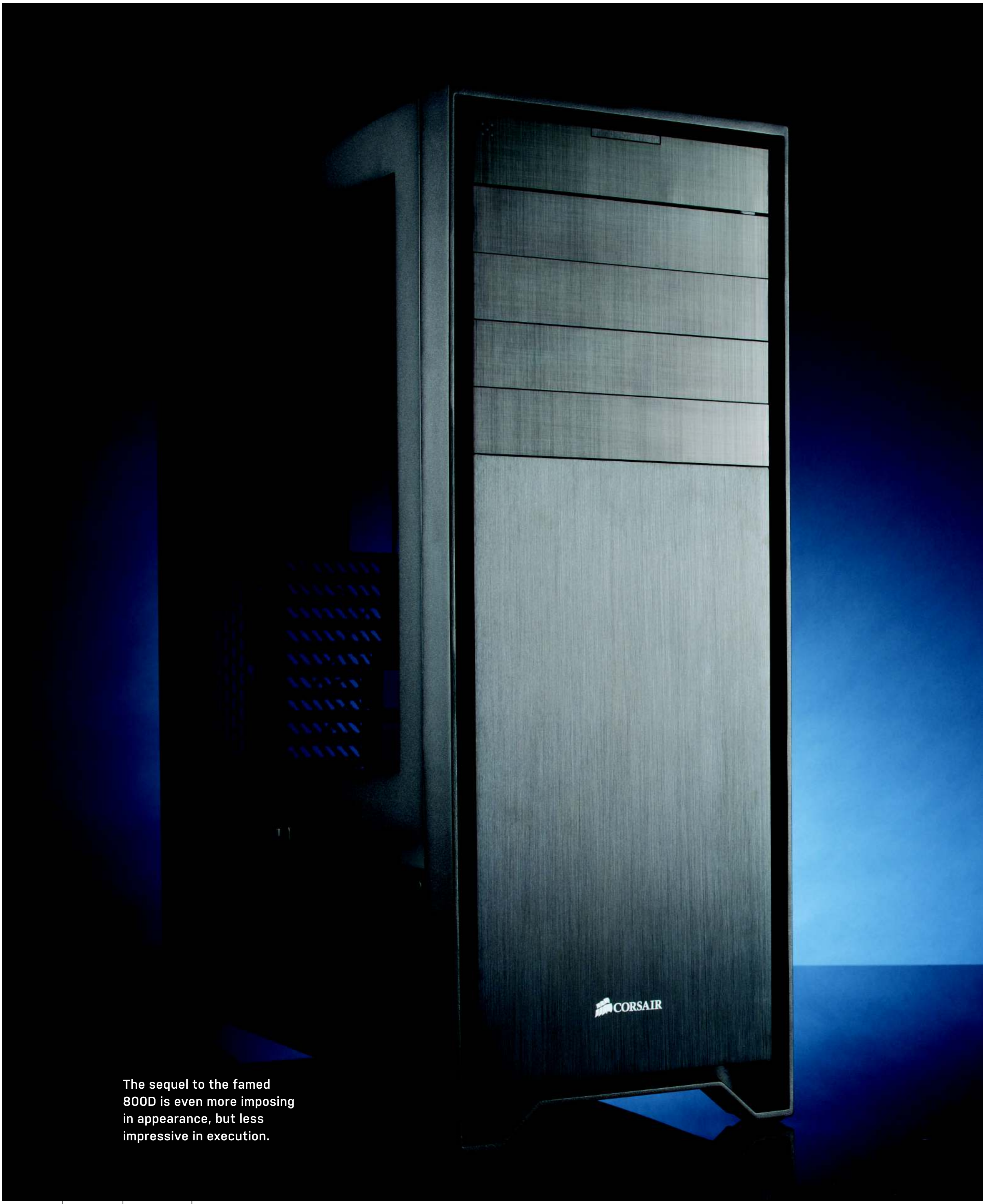
VERDICT 7

Google Chromebook Pixel

+ TESLA Beautiful construction; pleasurable track pad; 3:2 screen.

− EDISON Chrome OS dependent on Internet; power connector should be magnetic; expensive.

$1,450, www.google.com



The sequel to the famed 800D is even more imposing in appearance, but less impressive in execution.

Corsair 900D

Cue *Also sprach Zarathustra* for this monolith

THERE'S MUCH to like about Corsair's 900D, given that this cast-aluminum-and-steel chassis weighs as much as a tank and casts an authoritative presence underneath one's desk—if you can even fit the full-tower case under there.

Our problem? The case's adornments aren't as good as its overall construction. You could probably pull an Indiana Jones and survive a nuke if you wedged yourself into the approximately 26x10x27-inch case, but you're still going to have to fuss with its drive bays, magnetic filters, panels, and other upgrade-critical parts.

We love the aesthetic created by the case's simple, flat façade. A giant cover on the bottom half of the case's front pops off to offer easy, push-snap access to its three front 12cm fans (and corresponding fan filter). Locking the filter back into place can feel a wee bit flimsy, but we'd almost rather have that than the far more secure covers over the case's four 5.25-inch drive bays. You have to shove your hand into the case and do some blind-nudging of tabs to pop off the panels; we wish they were more accessible from just the front alone.

Also hidden behind a panel is the case's ample connectivity: two USB 3.0 ports (with an internal header) and four USB 2.0 ports. The stealth is a bit of a moot point, however, given that you won't be hiding much of anything when you're using said ports, and it's slightly annoying to have to flip open a panel just to access them—pretty as it might look.

We give Corsair all the credit in the world for making its case even more screw-free than what we'd otherwise expect to find when describing a case as "screwless." Removing the case's main side panels—on both sides—is as easy as pressing a button on the case's rear and gently pulling the panel away. While we're on the subject, we love the quasi-polarized, reflected look of the 900D's left-side panel: By eschewing the typical clear Plexiglas, Corsair adds to the mystique of the case's no-nonsense design.

The case's 5.25-inch bays all use easy-to-manipulate locking mechanisms to keep one's parts and pieces in place. The hard drive trays that fill the case's nine free bays—including three hotswap-friendly bays with SATA power and data backplane—are a bit fussier. The better word might be "flimsier," as they don't feel all that sturdy when you pull them out, push them in, or lock them into place. It's a minor quibble, but still a technical flaw for a case that breaks the bank at $350.

The case's 10 expansion slots require you to spin thumbscrews to lock your components into place. Get ready for some finger fun, because the case's design makes it difficult to use a standard-length shank screwdriver on these little guys.

We've long credited Corsair with setting the standard in cable management with the 800D, and the 900D doesn't disappoint. There's plenty of cable management built into the case's motherboard tray (standoffs, too), with eight large, rubberized holes and six smaller holes for routing cables every which way. And we love how you can stuff one or two power supplies into the case's bottom portion, which is accessible via its own flip-down side panel (with lame magnetic filter covering).

Although the 900D comes with five distinct locations for mounting liquid-cooling radiators (yay), the case's top is firmly screwed into the chassis itself—you're going to have to do work to install a radiator anyway, we realize, but we'd prefer to be able pop off the case's top sans instruments.

Finally, Corsair's case lacks any and all pizazz. You're paying 100 percent for construction: no flashy lights, no strips of LEDs, no ultra-quiet fans (just normal fans), no fan controller. And while we absolutely enjoy some of the clever (and durable) construction work Corsair's put into its chassis, we can't help but think that a few more tweaks could have taken this case from "very good" to "absolutely great"—especially when the case itself eats up such a large chunk of your building budget. –**DAVID MURPHY**

VERDICT 8

Corsair 900D

+ PACIFIC RIM Durable chassis; absurd amount of space; screwless; separate partition for up to two PSUs; three hot-swap bays; ample connectivity.

− POWER RANGERS Flimsy drive trays; odd angle for tightening expansion slot thumbscrews; screwed-in top; lame magnetic filters for lower-partition panels; bay covers require interior access; zero lighting.

$350, www.corsair.com



The included keyboard and mouse can be neatly tucked under the monitor.

HP Envy 23 TouchSmart

Clean-and-simple design at a premium price

WE HAVE TO HAND it to HP. Despite all the trendy all-in-one PC/tablet hybrid designs coming out, its new Envy 23 opts for a more traditional space-efficient AiO.

The 23-inch panel sits atop a sturdy base and is adjustable to 40 degrees. A 3-inch gap between the monitor and the 17x8-inch base lets you stow the keyboard under the monitor when not in use. Though hardly innovative, it gets the job done.

For amenities, the Envy 23 offers a slot-load Blu-ray combo drive and an HDMI-out port on the right; four USB 2.0 ports, an Ethernet port, an external audio-out on the back; and two USB 3.0 ports, a headphone/mic jack, and an SD card reader on the left. Finally, the power button is located on top of the display, which isn't exactly ideal, as we found ourselves accidentally turning it off when adjusting the monitor.

The monitor itself is a 1920x1080-resolution TN display that looks sharp and sports a very glossy, mirror-like finish. The panel's vertical off-axis is OK; its horizontal off-axis wasn't particularly impressive, but that's par for the course for TN panels. The display supports 10-point touch and is fairly responsive, but compared to, say, this month's Razer Edge tablet, it was perceptibly slower when dragging a digit across the screen.

Beneath the screen, the Envy 23 is equipped with a 3.1GHz Core i7-3770S, 12GB of dual-channel DDR3/1600, and a GeForce GT 630M. Our particular unit was also loaded with a beefy 3TB hard drive, which is much heftier than our zero-point's Asus ET2300 1TB solution.

The Envy's Core i7 processor allowed it to easily lump up the ET2300's quad-core Core i5-3330 in all of our CPU tests, especially in the multithread-hungry TechArp x264 benchmark, where the Hyper-Threading gives the i7 a 37 percent advantage. To our surprise, though, despite the Envy and ET2300 both sporting GeForce GT 630M GPUs, HP's offering lagged by 15.5 percent in both our Metro and 3DMark 11 graphics tests. Why? It might be because the Envy's 630M features a slightly slower .2 GTexel/s texture fill rate and 10MHz slower GPU clock, or it could simply be driver differences. Note to those who want reference drivers: Neither the Asus nor the HP allowed us to run the latest reference drivers.

As a more real-world game workload for the box, we played Portal 2, a nontaxing Source game, and achieved average frame rates in the low 30s on max settings at native resolution, but inconsistent dipping makes this setting ill-advised. On BioShock Infinite, we got an average 31fps on the lowest settings at 1080p, which suggests the game is only playable if you scale down the resolution.

On the audio front, the Envy 23 features Beats Audio, which gives the built-in speakers a nice bassy low end, which even works with headphones plugged-in. The speakers sound better than the ET2300's flat-sounding thumpers, but they still pale in comparison to a quality 2.1 speaker setup.

The included wireless keyboard is a bit flimsy, but it does its job. The mouse is equally competent, though you'll probably want to adjust the sensitivity out of the box. Whereas our zero-point features a detachable USB dongle that occupies a USB slot, the Envy's dongle is built into the PC itself. While that does free up a USB port, it also means you won't be able to use the peripherals on other computers.

The Envy 23 doesn't aim to reinvent the wheel and ends up being a decent PC in the process. While it certainly won't replace your gaming rig, it is a capable workstation/family PC. But at $1,840, it costs a whopping $540 more than the ET2300 without giving our zero-point much to be envious about. –JIMMY THANG

BENCHMARKS

	ZERO-POINT	
Stitch.Efx 2.0 (sec)	1,192	983.0
ProShow Producer 5 (sec)	1,841	1,779
x264 HD 5.0 (fps)	9.9	13.6
Metro 2033 (fps)	22	18 (-15.5%)
3DMark 11 (min)	1,333	1,127 (-15.5%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our zero-point all-in-one PC is an Asus ET2300 with a 3.0GHz Intel Core i5-3330, 8GB DDR3/1600, 1TB 7,200rpm hard drive, a GeForce GT 630M, and Windows 8. Metro tested at 1280x768 with Medium settings, Tessellation enabled.

VERDICT 7

HP Envy 23 TouchSmart

ENVY Sharp screen; beefy HDD.

GREED Underperforming GPU; overpriced.

$1,840, www.hp.com

SPECIFICATIONS

CPU	3.1GHz Intel Core i7-3770S
GPU	Nvidia GeForce GT 630M
RAM	12GB DDR3/1600
HDD	3TB (7,200rpm)
Optical	Blu-ray combo drive
Display	23-inch LED backlit TN LCD 1920x1080 (10-point touchscreen)

The LQ-320's radiator gives it 7.7cm of total length, once the fan is installed.



Zalman LQ-320 CPU Cooler

Respectable performance, but not for the price

ZALMAN HAS a well-earned reputation for high-quality air coolers. The "flower" design of its older all-copper heatsinks was eye-catching and distinctive, and its large (for the time) fans ran quietly even under load. Lately, though, liquid cooling has been all the rage. Closed-loop units from companies such as Corsair and NZXT are packaged with the cooling tubes and pump pre-attached to a radiator—referred to as an "all-in-one" (AiO) design. These units are much less expensive than cobbling together separate components, and there's little maintenance required. The LQ-320 marks one of Zalman's first forays into the AiO market, and it's a respectable part, though arguably priced too high for its performance.

Its noise level isn't a problem, though. Left to its own devices, the LQ-320 hovered around 1,700rpm under load, creating a noise level that was noticeable but not distracting. Even with the fan cranked to 2,000rpm, it wasn't that distracting and our overclocked Core i7-3960X test machine never cracked 70 C under a pretty hefty load. We use an internal Intel tool to load up the CPU to its limit, more so than with Prime95.

Under normal operating conditions, the LQ-320 noise level blends into the background—pretty much on par with a Phanteks or Noctua air cooler.

The radiator is large and in charge. At about 2 inches thick (that's thicker than two stacked case fans), to which you must bolt a 1-inch-thick fan. If you're sporting an LGA2011 board with tall RAM, there's a chance the DIMMs will bump into the cooler but it depends on your case and motherboard. Unlike a typical fan, the included unit has only four mounts on one side so it can only be mounted to the radiator where air is pushed through it.

The fan uses a 4-pin PWM plug that goes directly into your motherboard as opposed to the USB-controlled (and similarly priced) Corsair H80i or NZXT Kraken X40 "intelligent" coolers. If your mobo has really granular and intelligent control over fan headers, such as Asus Fan Xpert 2, it's probably OK. But if you're using a budget board that's "dumb," don't expect much control.

The pump is powered by a separate 3-pin plug that goes directly into an available mobo fan header. On boards that give you very little or no control over the fan headers, we'd advise you to get a $3.50 Molex-to-3-pin adapter to give the pump as much power as possible. Even on boards with control, we'd recommend that you make sure the pump is getting the proper voltage to get the full performance out of this cooler.

But although it lacks control software and unified cabling, it doesn't really need software tweaking, and you don't have to factor in software glitches. And plugging it directly into your power supply is not a major inconvenience. The biggest problem with the LQ-320 is actually its street price of about $90, which is virtually the same as the superior NZXT X40 and Corsair H80i. Granted, the X40 requires a 14cm fan mount, so it's not directly comparable. But since you can buy it for under $100, it's a factor, and the LQ-320 does not emerge victorious. If the LQ-320 settled into the $60-$70 range, it would probably fare better. –TOM MCNAMARA

VERDICT 8

Zalman LQ-320 CPU Cooler

+ MARTY McFLY High-quality construction; performs better than almost all air coolers.

− BIFF TANNEN Price is not in line with the competition; lacks software controls.

$110, www.zalman.com

SPECIFICATIONS

	Zalman LQ-320 (Quiet mode in Fan Xpert 2)	Zalman LQ-320 (Performance mode in Fan Xpert 2)	CM Hyper 212 Evo (Performance mode Xpert 2)	NZXT Kraken X40 (Performance mode)	Corsair H80i (Performance mode)
Ambient Air	20	20.5	23.8	22.5	25.2
Idle Temperature	34.4	30	36.2	32.1	33.3
Burn Temperature	68.7	67.7	74	63.1	**62.6**
Burn – Ambient	48.7	47.2	50.2	40.6	**37.4**

All temperatures in degrees Celsius. Best scores bolded. All tests performed using an Intel Core i7-3960X at 4.2GHz, on an Asus P9X79 Deluxe motherboard, in a Thermaltake Level 10 GT with stock fans set to High.

SPECIFICATIONS

Radiator Dimensions (H x D x W)	2 x 6 x 4.8 inches
Weight	1.9 lbs
Stock Fans	1x 12cm PWM
Socket Support	LGA1155/1156/1366/2011; AM2/ AM2+/AM3/AM3+/FM1
Additional Fan Support	One 12cm (screws included)



We installed the Accelero Hybrid cooler on our GTX 680 card in just over an hour with minimal profanity.

Arctic Cooling Accelero Hybrid GTX 680

A sweet DIY project for hardcore cooling freaks

BACK IN THE olden days of, like, three years ago, GPUs were quite loud and didn't cool very well, so aftermarket coolers were not necessarily required but were a good idea, and absolutely necessary if you wanted to heavily overclock the card.

Even if you didn't want to overclock but were a hardcore builder, installing liquid coolers made for a fun weekend project. Those days have mostly ended, now that Nvidia has gotten its act together with regards to quiet, well-designed coolers (AMD is getting closer, but isn't quite there yet for the high-end cards), and modern GPUs overclock quite nicely even with a stock cooler. But that hasn't stopped Arctic Cooling from developing exotic aftermarket coolers for all of today's high-end GPUs (Nvidia 600 and AMD 7000 series), so this month we strapped its Hybrid water-and-air cooler to a GTX 680 to see what the fuss was all about. Even though the cooler worked wonderfully, this is not a project for the faint-of-heart, as it would be tough to undo, but the gains it achieved in noise and heat dissipation were quite impressive.

The kit includes three separate pieces that must all be joined together: the water block and radiator, the cooling shroud with built-in fan, and the fan for the radiator. First, you must remove the stock cooler from your GPU, then whip out the Accelero Hybrid's Ikea-like step-by-step instructions, and start assembling the cooler. To do so, you glue some heatsinks to your board's VRMs, then attach the water block to the shroud, then attach the shroud to the card, then connect power for the fan and the pump. Finally, you connect the included fan to the radiator and then attach the radiator to your case's exhaust port above the PCIe slots. Installation took us roughly one hour, though that doesn't count leaving the card overnight for the thermal glue holding the heatsinks to dry. Overall, the instructions were easy to follow, and we had zero issues in testing, too, so we feel that means the instructions did their job, letting us install the cooler without breaking the card.

Once we had it up and running, we were astonished by the card's noise level, or better yet, the lack of noise. It's so quiet that you could play Crysis 3 in a library, with your case door off. Even when putting your ear next to the card under 100 percent load, you still don't hear much except for the occasional gurgle of water moving through the tubes, and we had the card overclocked to 1,100MHz from 1,006MHz. The temperatures were also superb, hitting only 60 C under full load overclocked, compared to 85 C with the stock cooler at stock clocks. We can definitely say this cooler works as advertised, runs silent and cool, and didn't break our GPU, nor was it difficult to assemble.

Now, should you buy it? Well, the performance gains we saw from overclocking the card were modest, as they always are. Also, this cooler cost $110 on Newegg as we went to press, which is a pretty penny to pay for an extra four frames per second in Crysis 3, for example. It is quiet, though, and it certainly runs cool, so if you're having heat and/or noise issues, this is one cooling solution we can wholeheartedly recommend. It definitely kicks ass. –JOSH NOREM

VERDICT 9 KICK ASS!

Arctic Cooling Accelero Hybrid GTX 680

+ **DIY** Totally silent; easy installation; great temps; fun DIY project.

– **STORE-BOUGHT** Small overclocking gains; kind of expensive.

$110 (street), www.arctic.ac



The Sharkoon's Skiller keyboard comes with almost every hotkey imaginable.

Sharkoon Skiller

Killer price meets not-so-killer performance

SHARKOON HAS stepped into the gaming-keyboard ring with its new budget plank called the Skiller, which is loaded with hotkeys and a macro-recording software suite. Those of you not familiar with Sharkoon should know that the company started out making cold-cathode PC lighting a decade ago, and has since expanded its offering with keyboards, mice, and other PC peripherals.

Sharkoon's newest keyboard manages to include some high-end features but ultimately has too many flaws—most notably a less-than-optimum typing experience—for us to recommend it.

On the plus side, Sharkoon includes rubberized WASD and cursor keys on the Skiller out of the box, making it easy to locate these gaming keys without taking your eyes off the screen. Rubberized WASD keys aren't a new thing, of course, but they're generally found on far pricier planks, such as Corsair's K60. For folks who don't care for the rubberized surface, Sharkoon includes a set of standard keys, as well as a tool for replacing them.

The right side of the Skiller has volume and mute keys, above which are the media controls, including pause, play, and stop. Sadly, the keys only work with Windows Media Player—we had no joy trying map to them to work with Pandora, VLC, or iTunes.

At the top of the keyboard there are wake, sleep, and power keys—the Skiller actually lets you power off your PC, put it to sleep, and wake it up using the last three buttons located in the top right-hand corner of the keyboard. Unfortunately, the power and sleep buttons cannot be disabled, which means an accidental tap of those keys during gameplay will put your machine to sleep or shut it down. We recommend changing these functions in the power options of your OS before you put the board into action.

The top left of the keyboard is rounded out with shortcuts to My Computer, Email, Windows Search, Windows Calculator, and Windows Media player. While useful to some, these dedicated keys seem out of place on a gaming keyboard.

Most budget keyboards don't include macro-recording software, but the Skiller does, which is a plus for folks on a tight budget who want big-dollar functionality. Sharkoon's software makes it quick and easy to create macro sets and it also makes the Skiller MMO- and RTS-friendly.

When you take into account the Sharkoon Skiller's $30 price, the inclusion of rubberized and textured WASD keys and macro software might make it seem like a steal, but the one deal-breaker to us is the keyboard's mushy feel. It's just not that pleasant to type on. Yes, we'll acknowledge that you won't get a more satisfying mechanical plank in this price range, but Sharkoon's Skiller is notably mushy by even mushy-membrane-key standards. –**CHRIS ZELE**

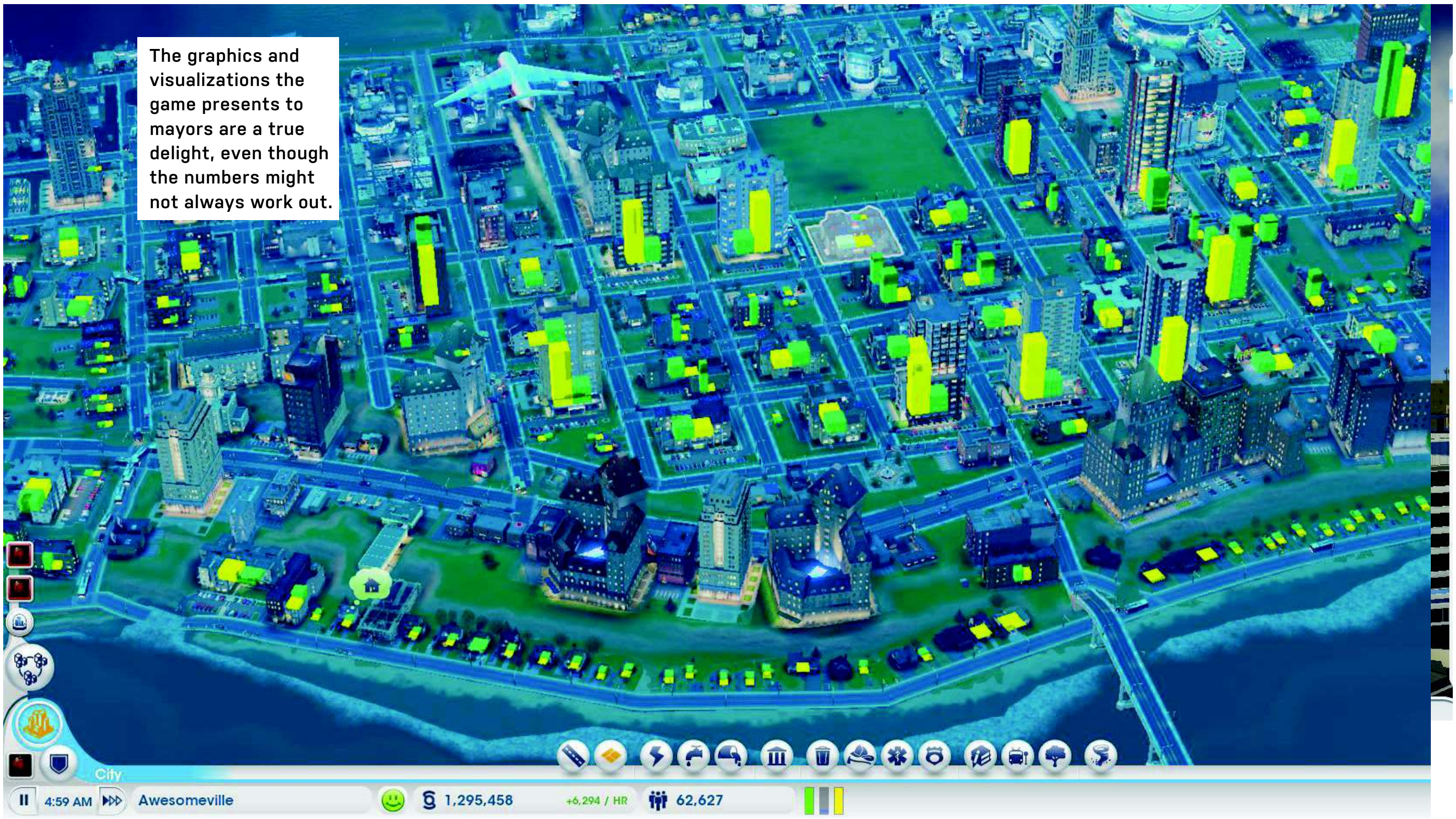
VERDICT 6

Sharkoon Skiller

+ STEAM Cheap; slew of hot-keys; rubberized WASD and arrow keys; macro-recording software.

– ORIGIN Membrane keys feel mushy; power and sleep too easy to hit; media keys only work with WMP.

$30, www.sharkoon.com



The graphics and visualizations the game presents to mayors are a true delight, even though the numbers might not always work out.

SimCity

EA's suspended marketing campaign says it all

JUST IN CASE we get bogged down reviewing Electronic Arts' poisoning of an otherwise excellent franchise instead of getting into the nitty-gritty of the game itself, allow us to present a Cheetah Speed review of SimCity up-front (assuming EA has turned that feature back on by the time you read this).

Electronic Arts and developer Maxis found themselves a little plot of land in the grand region of Gamersdreams. Within this area, they planned to build a lovely place called SimCity—a glorious, majestic city full of rich technology and beautiful visuals, a true upgrade to its previous incarnation called "SimCity 4" that would be beloved by millions worldwide.

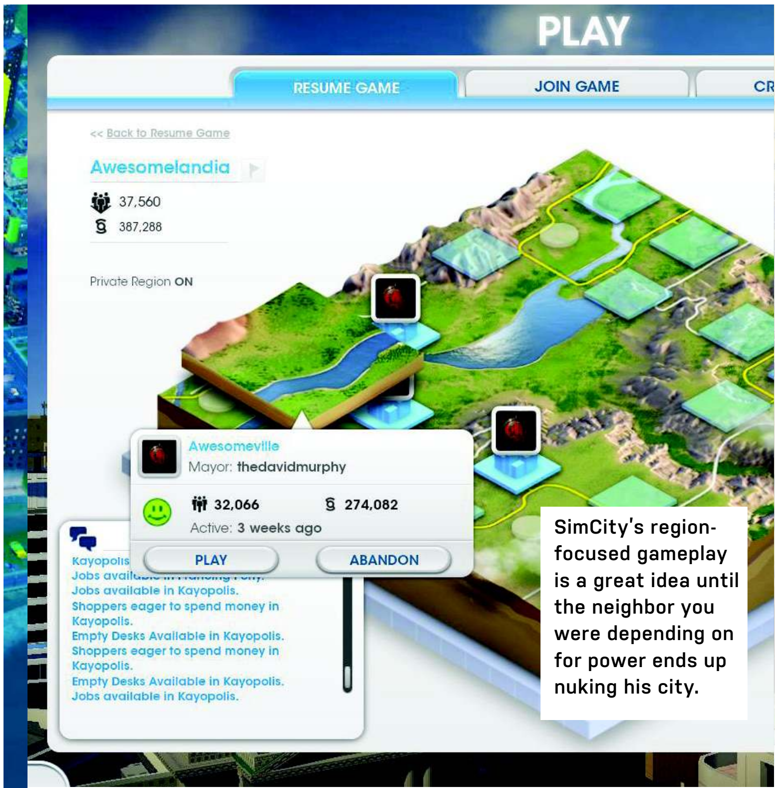
Maxis built this town—this game, to put the metaphor to death—and forgot to connect the infrastructure. And just like the unpleasant result you get when you attempt to build a town in SimCity sans services (or when the game glitches away your fire trucks, police cars, and garbage trucks), SimCity as a whole suffers greatly from Electronic Arts' and Maxis's failure to make a game that, quite simply, works.

Where do we begin? The core of this new SimCity centers on its always-on Internet requirement, which allows you to co-develop larger regions of cities and kills your ability to ever work on MaximumPCopolis in the middle of a plane flight. It's an ongoing war of words between Electronic Arts and the third-party modding community as to whether the game could have made do with an offline, single-player mode sans coding nightmare—we're pretty confident that the phrase "DRM" instead of "awesome new functionality" fueled Electronic Arts' decision this time around.

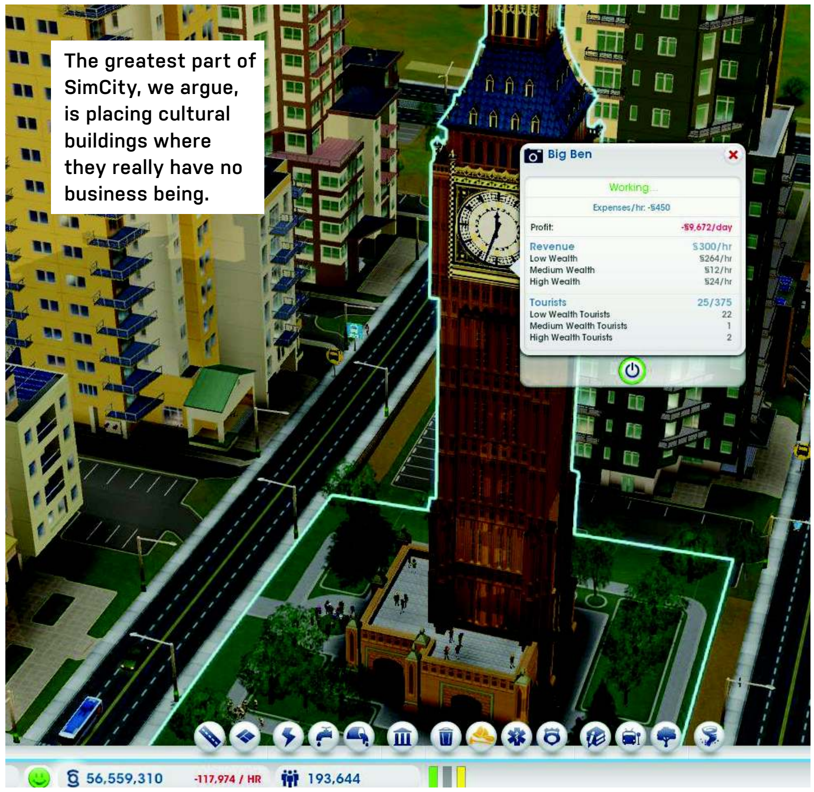
If you've ever heard of the SimCity franchise, you know how the game generally works: You paint residential, commercial, or industrial zones to encourage different elements to move into your newly minted town. You draw all the roads; you supply the power; you clean up the sewage; you plop down the Eiffel Tower in the middle of your farming community; etc. Somewhere in all this, you learn from mistake after city-planning mistake, and end up building your dreams.

It's no question that SimCity looks the best it has in some time, minus a few graphical oddities here and there for road connections, building placement, and the game's need to figure out important bits like elevation on your behalf—why SimCity eschewed any and all terraforming options, which would allow gamers to customize their plots of land in a multitude of awesome ways, we'll never know.

The GlassBox simulation engine serving as the game's brain looks great, too—on paper. Contrary to Electronic Arts' marketing, the game does not in fact simulate the life of every individual citizen in your city. Nor do they really have lives, even though the game's (almost unnecessary) level of detail allows you to follow them about their day if you truly need your "Sims" fix.



SimCity's region-focused gameplay is a great idea until the neighbor you were depending on for power ends up nuking his city.



The greatest part of SimCity, we argue, is placing cultural buildings where they really have no business being.

If you do, you might notice some peculiarities. For example, your Sims leave "their" house at the beginning of the day to hit up the first job they can find. Once done, they head home to the first open house they can find—and are affected by that house's modifiers, like its educational level—creating what amounts to a massive amount of non-addressable gridlock as these roving bands of people all attempt to chaotically fill up your city's infrastructure single-file.

In other words, you design a city based on the patterns you expect its inhabitants to have, but they have no patterns whatsoever. And no brains. Sims would rather flood a tiny road that's a direct route to their goal than take a slightly longer open avenue; 30 busses will follow each other around your roads and absolutely destroy your city's traffic in a quest to pick up the same passenger, after passenger, after passenger; the game's Casinos flat-out don't work, thanks to however GlassBox is scripting its visitors.

We continue.

Other fun game-breaking bugs include a particularly unpleasant situation where deleting stretches of road with service vehicles on it (police, fire, ambulances, etc.)—a necessity when one needs to renovate areas of one's city within the game's heavily constricted building area—deletes these vehicles forevermore. Even if you remove and replace the vehicle's station, absolutely no service vehicles will go out to attend to your city's issues until you've built more stations than you previously had (a budgetary nightmare).

Here's our favorite: Suppose you've built your city on a river. Lovely sight, right? Only, you're eventually going to run out of water for your city—even if you've placed a water tower *right next to the freakin' river*—because the whole concept of the game's water table is either glitched or just horribly designed. Heaven forbid you've elected to build a city on a flat, desert plain: You'll have to turn to the strange art of placing water treatment plants next to your sewage collection if you want to tap into an infinite water supply. Otherwise, your sims will eventually starve.

What else? Sims grouse about crime even if there isn't any; the numbers in the game's various data boxes don't mathematically work out; one mishandled nuclear power plant (either through Mayoral stupidity or unavoidable in-game disasters) will ruin your city without any clear method for cleaning it up; there's no way to upgrade your roads in any kind of speedy, universal fashion—we hope you like clicking—and worst of all, SimCity either holds your hand too much or leaves you stranded without much explanation for most of the game's functions.

Though we might sound like we're nitpicking, that's the point. SimCity is an incredibly enjoyable game at first. But as one passes through the novice stages of building anything, anyplace, anywhere, and seeks out a greater strategy for combining creativity with ideal city-building techniques, the title falls apart faster than your infrastructure with a six-digit population.

We found ourselves dreading having to throw more of our time at this game's broken formula. We suspect you will as well, unless Electronic Arts has managed to pull a rabbit out of a SimHat by the time you read this review and patched up the game to playability. If, instead, the company has launched a DLC marketplace for buying new iterations of SimBuildings, feel free to lop off three points from this game's final score. **–DAVID MURPHY**

VERDICT 4

SimCity

+ SIMCITY 4 Lovely graphics; unique multiplayer component; city specializations have a great potential to add uniqueness to the game.

– CITIES XL Always-on Internet requirement; numerous game-breaking bugs; Sims lives not "simulated;" numbers don't add up; game lacks terraforming.

$60, www.simcity.com, ESRB: E

THE BUILDS

BUDGET



INGREDIENTS

PART		PRICE
Case	Rosewill R519-BK w/500W PSU	$70
Mobo	ECS H77H2-M3 Micro ATX **NEW**	$65
CPU	Intel Core i5-3350P **NEW**	$180
Cooler	Stock Intel cooler	$0
GPU	Asus Radeon HD 7790 DirectCU II 1GB **NEW**	$150
RAM	4GB (1x 4GB) Crucial Ballistix DDR3/1333 **NEW**	$32
Optical Drive	Samsung SH-224BB **NEW**	$18
SSD	A-Data Premiere Pro SP600 32GB Cache Drive **NEW**	$45
Hard Drive	WD Caviar Blue 500GB **NEW**	$55
OS	Windows 7 Home Premium 64-bit	$90

Approximate Price: $705

THIS MONTH, we changed our Budget box based on the results of the three-way battle in this issue (page 24). Say goodbye to the Phenom II X4 965 CPU, and hello to the quad-core Ivy Bridge Core i5-3350P. The "P" at the end means it has no built-in graphics, which is no biggie. You may ask how we managed to spend about $75 more on this system's CPU without busting our budget? Well, we downgraded the SSD from a 128GB Samsung 840 to a 32GB caching SSD instead. Moving to Intel silicon lets us scale back on a dedicated SSD but keep some SSD-like performance by using a caching drive with the Intel H77 chipset. We've also upgraded the video card from an AMD Radeon HD 7770 to the new HD 7790, which should increase average game performance by about 25 percent.

BASELINE



INGREDIENTS

PART		PRICE
Case	Corsair Carbide 200R	$60
PSU	Cooler Master Silent Pro M2 720W **NEW**	$95
Mobo	Asus P8Z77-V	$175
CPU	Intel Core i5-3570K	$220
Cooler	Cooler Master Hyper 212 Evo	$31
GPU	MSI Radeon 7870 GHz Edition	$210
RAM	8GB Corsair Vengeance DDR3/1600 **NEW**	$48
Optical Drive	Samsung SH-224BB **NEW**	$18
SSD	Samsung 840 Pro 128GB	$130
Hard Drive	1TB Seagate Barracuda	$70
OS	Windows 7 Home Premium 64-bit	$90

Approximate Price: $1,147

SINCE THIS tier hasn't seen many new products lately, we're not changing much this month. However, we've had Corsair's HX650 in this build for quite a while, and though it's a fine piece of hardware, we have now switched to the 720-watt Cooler Master Silent Pro M2 720W used in last month's Build It. We like the Cooler Master because it offers twice as many PCI Express connectors and a higher wattage ceiling for about the same price as the Corsair. Meanwhile, the desktop PC RAM market continues to destabilize as manufactures shift to putting memory in mobile devices, so prices have become unpredictable. That means that as of press time, the Crucial RAM we were using is pricey, but Corsair Vengeance is a better buy, so inside the rig it goes.



PERFORMANCE

THIS CORE ELEMENTS of this tier (motherboard, CPU, and RAM) are basically in a holding pattern until Intel's Ivy Bridge-E CPUs come out, but their release date hasn't been nailed down yet. This build uses the older Sandy Bridge-E chip, but it's still very speedy. And even though there's been a flurry of activity in the liquid-cooler market, the Kraken X40 still has an excellent price-performance ratio and runs almost silently, so we're sticking with it for now. We'll be getting our hands on more liquid-coolers soon.

Meanwhile, the "Vapor-X" version of Sapphire's Radeon HD 7970 GHz Edition is down to $420, which is only $25 more than the regular 7970 we used last month from Gigabyte. The Sapphire card can achieve higher overclocking speeds since the "GHz Edition" comes from a higher "bin" (cards are tested at the factory to see which category, or bin, of performance they actually qualify for), and the vapor chamber above the GPU is also worth the moderate price premium. These chambers work like heat pipes, but their larger volume means even better temperatures.

INGREDIENTS

PART		PRICE
Case	NZXT Phantom 630	$180
PSU	Corsair HX750	$130
Mobo	Asus Sabertooth X79	$325
CPU	Intel Core i7-3820	$290
Cooler	Kraken X40	$80
GPU	Sapphire Radeon Vapor-X HD 7970 GHz Edition **NEW**	$420
RAM	16GB Corsair Vengeance	$100
Optical Drive	Asus BW-12B1ST	$60
SSD	Corsair Neutron GTX 256GB	$200
Hard Drive	3TB Seagate Barracuda	$134
OS	Windows 7 Professional 64-bit	$140

Approximate Price: $2,059

For more of our component recommendations, visit www.maximumpc.com/best-of-the-best.

KICK ASS GEAR

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VIDEO CARD
MSI GeForce GTX 670 Power Edition
$375, www.msi.com



SSD
Samsung 840 Pro 512GB
$450, www.samsung.com



FULL-TOWER CASE
Azza Genesis 9000
$180, www. azzatek.com



MID-TOWER CASE
Thermaltake New Soprano
$120, www.thermaltake.com



CPU COOLER
Cooler Master Hyper 212 Evo
$32, www.coolermaster-usa.com

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